Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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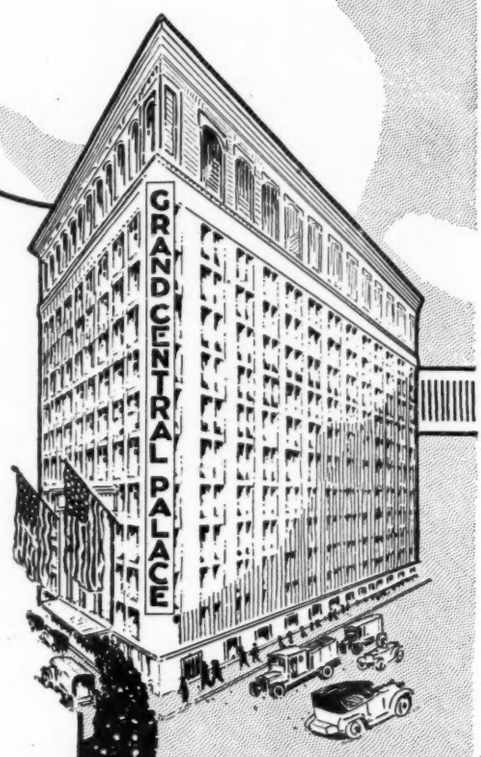

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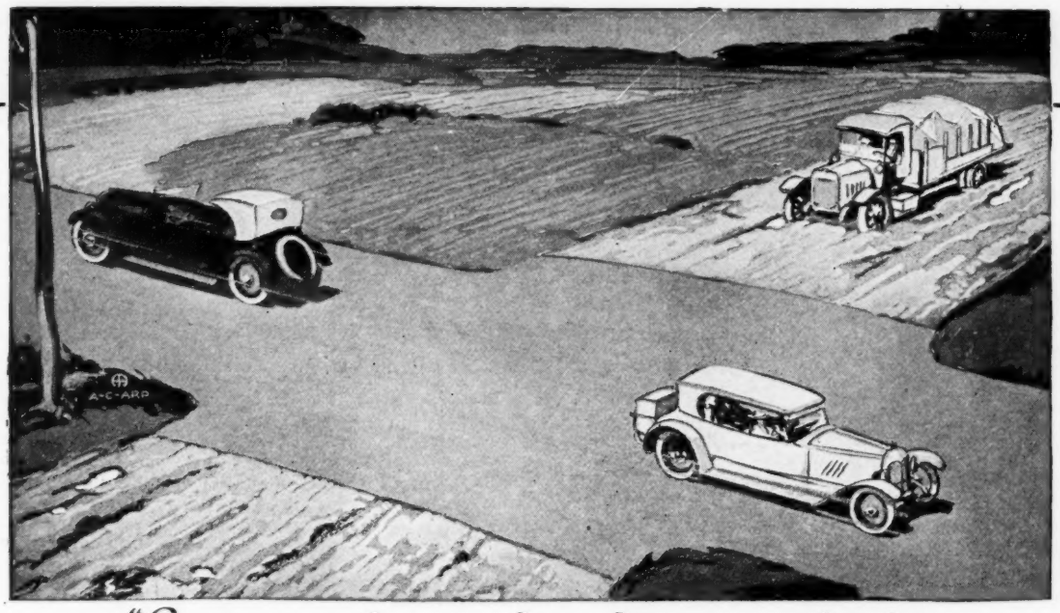

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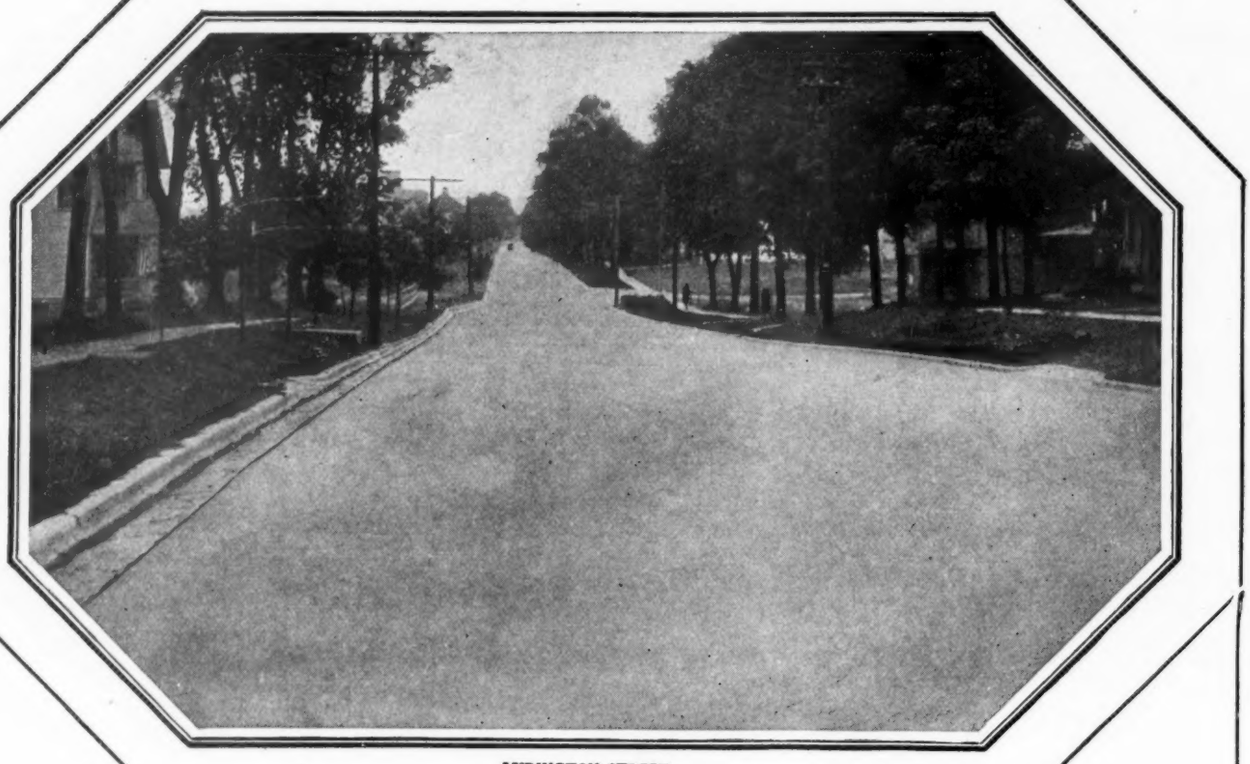

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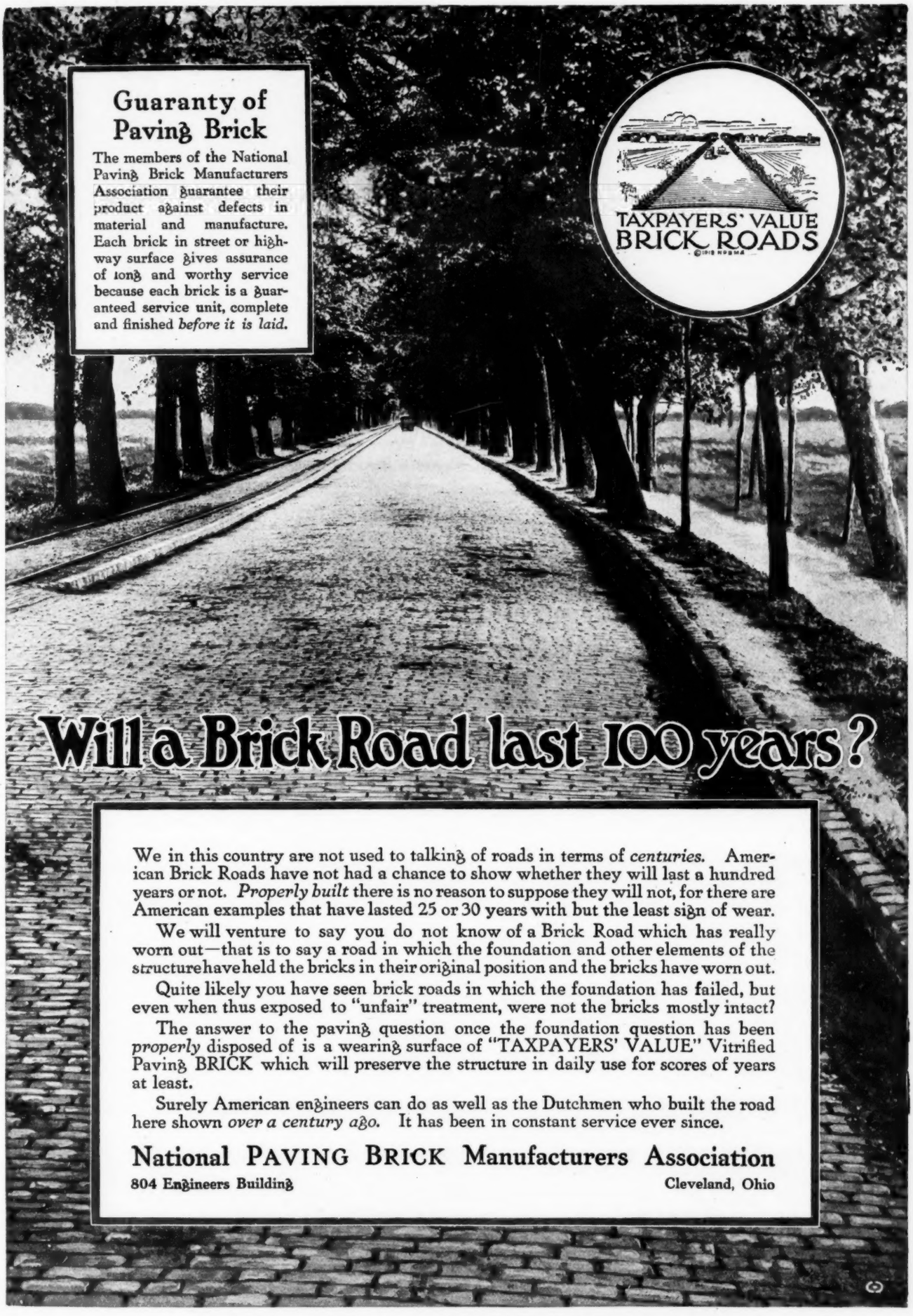
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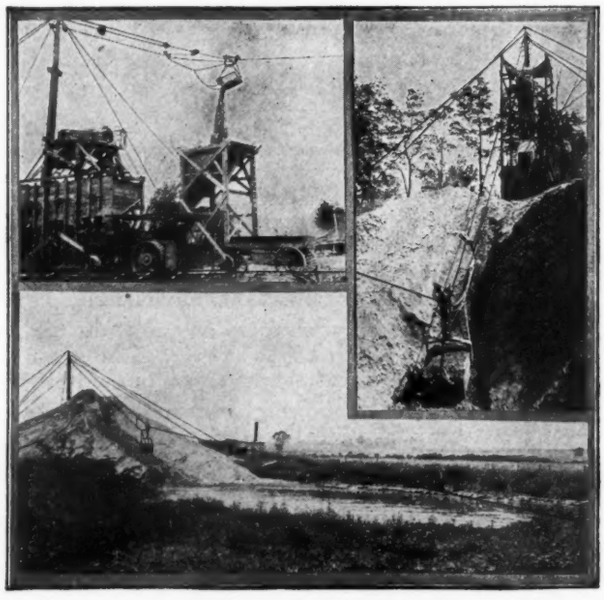

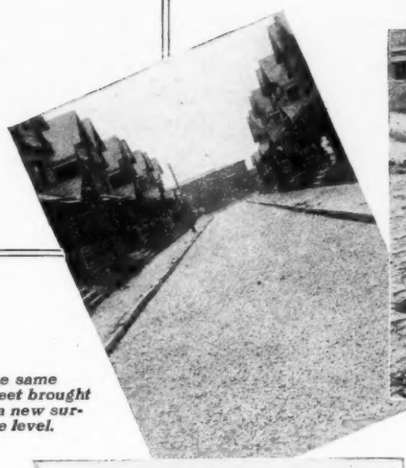

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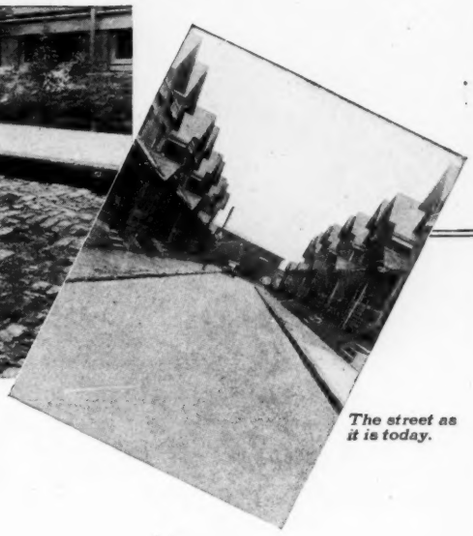
Section of Race Street above 32nd, showing the ravages of traffic on pavements of this type.



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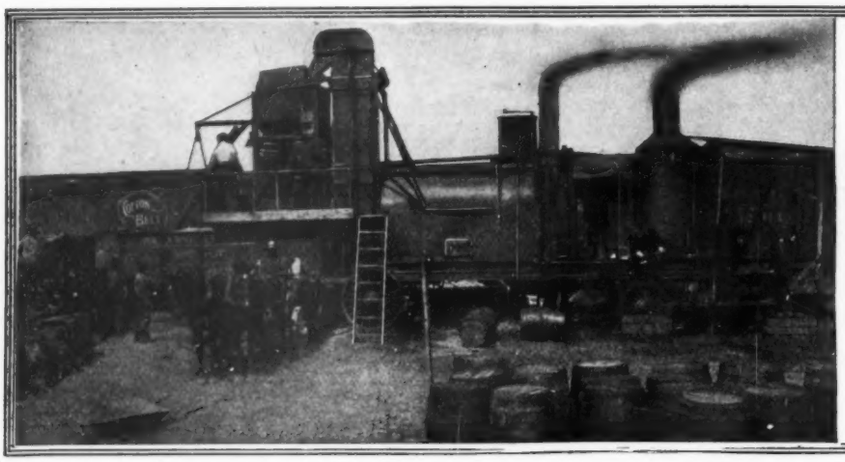

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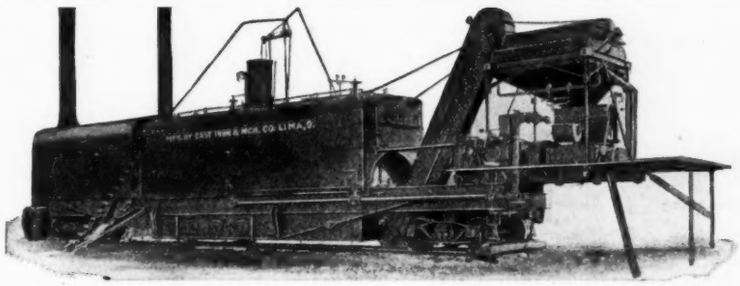

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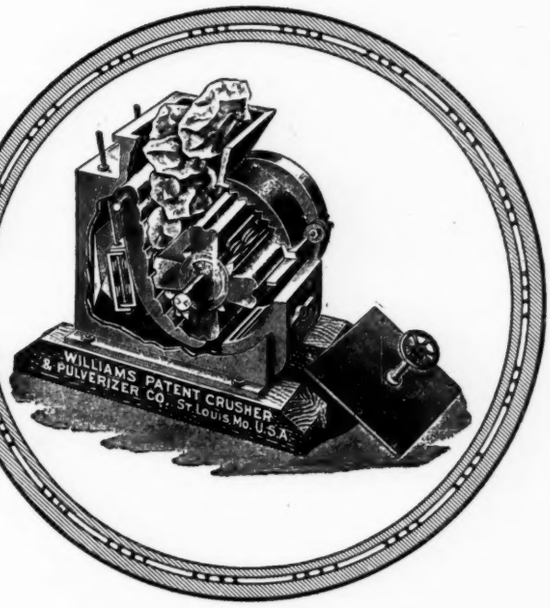

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Dee Co., Wm. E.
Madison Foundry Co.

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The Barrett Co.
H. H. Robertson Co.

Joint Fillers (Paving).
The Barrett Co.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.

Manhole Covers.
Madison Foundry Co.
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Ford Meter Box Co., The

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

Concrete Reinforcement

Fulfills every engineering requirement.

Send for our book on road building

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Reg. U. S. Pat. Office

AN improved asphaltic concrete pavement composed of finely ground slag and especially prepared asphalt.

Bitoslag has demonstrated in practice that is is designed to meet all the demands of modern traffic.

Write for descriptive matter.

Bitoslag Paving Co.

90 West St., New York, N. Y.

Robertson Curb Reinforcement

Robertson Curb Reinforcement does more than protect the edges of the curb. It forms a positive anchor for the bar while it reinforces the concrete. It is manufactured from new billet steel and heavily galvanized after being fabricated. Information on request.

HH HIGHWAY MATERIALS ROBERTSON CO BUILDING PRODUCTS

Formerly Asbestos Protected Metal Co.

PITTSBURGH, PA.

REILLY'S IMPROVED PERMANENT CREOSOTE OIL

This oil is far superior to any other creosote oil in permanency. Contains not even a trace of tar or other adulterants. Cannot "bleed." Not soluble in water. Will not evaporate in intense heat. Waterproofs. Gives permanent satisfaction.

The life and service of your wood block pavements depend solely upon the quality of creosote oil they contain.

Therefore—see that your paving contract specifies treatment with this better preservative.

REPUBLIC CREOSOTING CO., Indianapolis, Ind.

Plants: Indianapolis Minneapolis Mobile Seattle Norfolk

"BEREA" Sandstone Curbing

Pioneer in the field

PRODUCED BY

The Cleveland Stone Co.

Main Offices:
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The ELGIN LINE OF Motor Driven Street Cleaning Machinery

Elgin Sales Corporation

501 Fifth Avenue New York — U. S. A. — 1340 Old Colony Bldg. Chicago

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Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
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Heltzel Steel Form & Iron Co.

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Acme Motor Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Reo Motor Car Co.
Service Motor Truck Co.
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Motor Trucks.
Acme Motor Truck Co.
Autocar Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Reo Motor Car Co.
Service Motor Truck Co.
J. C. Wilson Co.

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Acme Motor Truck Co.
Autocar Co.
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Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
Reo Motor Car Co.
Service Motor Truck Co.
J. C. Wilson Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Paints (Asphalt).
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Barrett Co., The
H. H. Robertson Co.
Truscon Steel Co.

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The Barrett Co.
Republic Creosoting Co.

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Murphysboro Paving Brick Co.
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Warren Bros. Co.

Paving Joint Compound.
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The Barrett Co.
H. H. Robertson Co.
Truscon Steel Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
H. H. Robertson Co.

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F. C. Austin Co., Inc.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

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Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Koehring Machine Co.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
H. H. Robertson Co.
The Texas Co.

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American Cast Iron Pipe Co.

Pitch Filler.
The Barrett Co.
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Austin-Western Road Cach. Co.

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Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. C o.

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Austin-Western Road Machinery Co.

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De Laval Steam Turbine Co.

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American Steel and Wire Co.
H. H. Robertson Co.
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The Barrett Co.
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The Texas Co.
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Heltzel Steel Form & Iron Co.
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Austin-Western Road Machinery Co., The
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Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Mayer, F.
Warren Bros. Co.

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Austin-Western Road Machinery Co.

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The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

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Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.

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Austin-Western Road Machinery Co., The
Williams Patent Crusher & Pulverizer Co.

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East Iron & Machine Co., The

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Kalamazoo Fdry. & Mach. Co.

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Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis
Vitrified Pipe Mfrs. Assn.

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Stewart, W. H.

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Coldwell-Wilcox Co.

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Street Paving Material.
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The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

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Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

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Austin-Western Road Machinery Co., The
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

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Mensch, L. J.

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Alger Supply Co.
Littleford Bros.

Tarvia.
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Testing Chemists.
Dow & Smith
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

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Austin-Western Road Machinery Co., The

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Electric Ozone Sterilizer Co. of America.
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Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Company

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

Autocar

George, Hankins & George, Contractors, of Richmond, Va., used a fleet of 10 Autocars in excavating for the new Federal Reserve Bank, at Franklin and Ninth Streets, Richmond.

For Two Months these Autocars Worked 24 Hours Every Day.

It is because the Autocar Motor Truck does stand up and deliver economically that half of all the Autocars this Company can make are bought by concerns that already use Autocars.

The 8000 Autocar users in 450 different lines of business have found, too, that the unusual system of Autocar aftersale service through direct factory branches and dealers is the best assurance they can have of continuous motor truck operation.

Chassis (1½-2 ton)
$2300 97-in. wheelbase
$2400 150-in. wheelbase

The Autocar Company, Ardmore, Pa.
Established 1897

The Autocar Sales and Service Company

New York	Providence	Wilmington	Washington	San Francisco
Brooklyn	Worcester	Atlantic City	Pittsburgh	San Diego
Bronx	New Haven	Chicago	Los Angeles	Sacramento
Newark	Philadelphia	St. Louis	Stockton	Fresno
Boston	Allentown	Baltimore	Oakland	

Represented by these Factory Branches, with Dealers in other cities

Printed as insert to Municipal and County Engineering, Chicago, Ill., November, 1919.

MOTOR TRUCK OPERATION AND ACCOUNTING LI

Many interesting letters are received by the editor from engineers in state highway organizations who have opportunity to observe the relative economy of horse and motor haulage. Extracts from a few such letters follow:

Frank W. Webster, Resident Engineer, Tennessee Department of Highways, Jonesboro, Tenn., writes:

In my opinion motor trucks are considerably more economical for the transportation of road-building materials than horse-drawn vehicles. They are also considerably more efficient. We are doing a great deal of construction work in our county, building principally water bound macadam roads, and we are doing all our hauling with motor trucks. The roads over which the materials are hauled are graded, red clay roads. It has been our experience that it costs approximately 40 cents per cubic yard per mile of haul to transport macadam in motor trucks over these roads. The prevailing local rate for teams is $7 per day. The average load a team can haul over our roads is 1 cu. yd., and the average number of trips of a mile haul is nine. So that it would cost approximately 68 cents per cu. yd. per mile to transport this material with horse-drawn vehicles, or 70 percent more than the cost of hauling in trucks.

R. W. Owens, Resident Engineer, Maryland State Roads Commission, Hyattsville, Md., writes:

In the Hyattsville Residency, and I think I can safely say throughout the State, it has been shown conclusively that the saving effected in hauling by trucks instead of by teams is at least 60 percent.

Of course it goes without saying that the longer the haul the cheaper the cost would be per ton mile. I have not used any trucks with trailers and am rather of the opinion that as a general rule this method is just a little bit too cumbersome and unwieldy.

I feel that unlimited possibilities for economical work are offered by the use of tractors, particularly for pulling road machines, Minnesota road planers and drags of an ordinary type.

While not exactly in line with the subject, it may not be amiss to give some data resulting from direct personal observation as to the uses and advantages of a tractor on gravel and sand clay roads of a type to be found in Southern Maryland.

To convey a Little Western Road Machine which is used on the berms or shoulders requires 4 horses, which will cost for a 10-hour day, say, $12. The average length of road which can be gone over once is about 12 miles, the resultant cost per mile being $1.

A tractor in the locality which I have in mind can be hired for $2 per hour, and will make, possibly, 40 miles in a 10-hour day. This will give a cost of 50 cents per mile. I think the same ratio of cost will exist in similar operations, that is to say, in the use of a Minnesota road planer or in the use of the ordinary type of drag.

H. J. Spelman, Division Engineer, West Virginia State Road Commission, Huntington, W. Va., writes:

Of course each particular road job is an individual problem, and the question of haulage must be studied and solved for each job with consideration of a variety of factors, such as size, length of haul, character of roads to be hauled over, local team supply, accessibility and cost of fuel, etc.

PACKARD TRUCKS AS OPERATED ON VARIOUS MUNICIPAL AND COUNTY JOBS.

Out of the Crucible of War Needs Pours Approval of the

Wilson ***Dependable Motor Trucks***

Eighteen months before the massed engineering brains of the automotive industry evolved the Class B Army motor trucks, acknowledged to be the world's best truck, Wilson engineers designed and placed in production the 3½ and 5-ton Wilson.

After the Class B truck was manufactured, it was found that in 22 distinct instances Wilson engineers and the War Department engineering force agreed in essentials, which demonstrates the pleasing fact that the Wilson design anticipated the trend of the best engineering practice by a year and a half.

The points of similarity are briefly summarized below:

Motor, Axles (worm drive), Transmission, Radiator, Brakes, Load Distribution, Wheel Base, Frame, Clutch, Drive and Propeller Shafts, Springs, Spring Clips, Steering, Control, Hotchkiss Drive, Artillery Type Wheels, Dash, Fenders, Seat, Gasoline Feed, and other minor points.

Folder showing in detail these various features will be sent on request.

In addition to this compliment paid by the leading automotive engineers of America to Wilson design, by concurring in practically every major thought of Wilson engineers, the actual experience of Army officers with Wilson trucks makes interesting reading. We have prepared a little booklet showing what the Army actually thought of the Wilson truck in the service of Uncle Sam, and a copy is free for the asking.

YOU know the Wilson truck is a good one.

NOW is the time to find out if YOU can get the selling franchise in your territory.

Write or wire the factory today.

1½, 2, 3½ and 5 ton models—all worm drive.

J. C. WILSON COMPANY, 36th Year Detroit, Mich.

In general I find that where the average haul is over ¾ of a mile, animal haul is not as cheap as motor haul.

With teams at 50 cts. an hour, and fair macadam roads to haul over, I have hauled materials for 20 cts. per ton mile with average hauls considerably over ¾ mile. With fair to poor dirt roads I have seen these costs run from 25 cts. per ton mile to 35 cts. per ton mile. I have not had opportunity to collect any detailed data recently, but with teams at present at 80 cts. per hour it is apparent that animal hauling has increased at least 60 percent in cost.

With traction engines at $1.25 an hour, including all costs in that price, I have seen material hauled from 12 cts. to 15 cts. per ton mile over fair roads where the hauls average over two miles.

With rented motor trucks at $2.25 an hour, and four mile hauls, I have had material hauled for 20 cts. per ton mile on good roads.

I have demonstrated to my own satisfaction that under usual conditions, where the haul exceeds one mile it is almost never economy to use animal power.

I have never been able to determine the relative economy of trucks and traction engines.

It occurs to me as being probable that industrial track and engines will prove more economical than either trucks or tractors where the quantity of material to be hauled from one location is considerable, but I do not know how much material would need to be handled to justify the expense of such a layout.

S. M. Rudder, Division Engineer, Missouri State Highway Department, Ilgenfritz Bldg., Sedalia, Mo., writes:

I do not know of a mile of road that we could have built in my district of 19 counties if we had been obliged to depend on horse drawn vehicles to deliver our material.

For short hauls there is very little data to compare the relative economy and I have very little or no data available in figures, but I have rough data enough to know that it is very much more economical to haul by means of trucks. I have made no observation on hauling with trailers and tractors.

For instance, I asked one contractor what it was costing him to haul stone for a water bound macadam road with his trucks. He had 4 3-ton trucks and hauled something over 3 cu. yds. on them. His quarry and crushers were at the end of the road and his maximum haul was 6 miles—average haul about 2½ miles. His answer was, 8 cts. per yd. per mile. This included the operator at $4 per day, and oil and gas for the trucks. Of course he can give more accurate data on the entire cost after his work is completed, as he has a depreciation charge on trucks, tires, etc., that should be figured in—but compare this with, say 50 cts. per ton mile for team hauling and there is a big margin in favor of the truck haul.

J. E. Moreland, District Engineer, Tennessee Department of Highways, Cowan, Tennessee, writes:

During the period since motor hauling became a factor in highway construction I have been engaged in overseeing work which was done by contract, so I have very little first hand data on the subject, but our average con-

FLEET OF FOUR ACME DUMP TRUCKS, EQUIPPED WITH BURCH STONE SPREADERS, AS OPERATED BY THE J. L. SEEDS CO. ON ROAD WORK NEAR MARION, OHIO.

Civic Transportation

The problem of haulage is vital to every city's welfare. On efficient transportation depends the health, safety and appearance standards of the community—and *efficient transportation* means *motorization.*

Because of proven performance and economy of operation, in all manner of civic haulage, SERVICE Motor Trucks have been installed by Chicago, Indianapolis, Columbus, Atlanta, Kansas City and many other cities.

The SERVICE Special Equipment Department is prepared to furnish Street Cleaning Apparatus, Fire Fighting Apparatus, Road Oilers, Winches, Hoists, Dump Bodies and other special equipment.

SERVICE Motor Trucks will solve YOUR civic transportation problem.

Write for catalog and full information

SERVICE MOTOR TRUCK CO. Wabash Indiana. U.S.A.

Distributors in all principal cities

New York
87-89 West End Ave.

Chicago
2617-25 So Wabash Ave.

Service
MOTOR TRUCKS
Builders of Business

tract prices on hauling material dropped about 50 percent with the advent of the truck.

I know several contractors who have motorized their outfits, and they say that the saving over wagon hauling pays for the trucks in from six to ten months.

My experience with tractor hauling has not been very satisfactory, but this was because the equipment was not adapted to the work, and I believe that with the right equipment tractor hauling is fully as economical as truck hauling.

F. F. Mengel, Division Engineer, Wisconsin State Highway Commission, Grand Rapids, Wis., writes:

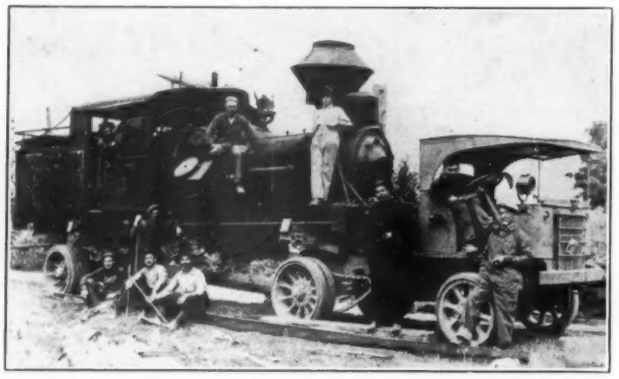
We have hauled materials with motor trucks and tractors on several jobs in this Division this year, and have been able to accomplish work which would have had to remain unfinished if we had not used the above equipment, because of lack of teams.

J. A. Reagan, District Engineer, Tennessee Department of Highways, Sweetwater, Tenn., writes:

In Unicoi County, Tenn., the Mack truck used for hauling crushed rock for macadam work was replaced by wagons for 12 days. Part of the time seven wagons were used and part of the time six. The wagons cost $6 per day each, making the total cost per day average $40, or $480 for the 12 days. The truck would have cost $4.50 for driver, $1.50 for gasoline and $0.25 for oil, making $6.25 per day for the truck, or $75 for the 12 days. This is a difference in cost of $405 in two weeks in favor of the truck.

Garford 10-Ton Tractor Transports Locomotive in Northwestern Timber Lands

Proof that a motor truck of modern design and construction is capable of most any transportation task is contained in the accompanying photograph. Here is a Garford 10-Ton Tractor transporting, with the aid of



GARFORD 10-TON TRACTOR TRANSPORTING LOCOMOTIVE IN NORTHWESTERN TIMBER LANDS.

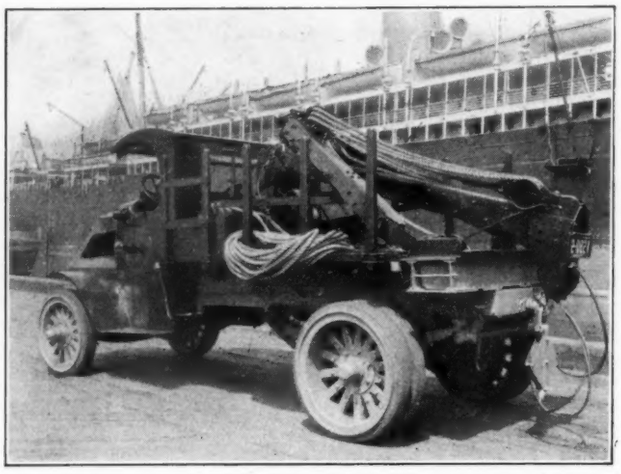
a trailer, one of the big logging locomotives used in the lumber camps of the Northwest. The locomotive is the property of the Clipper Shingle Co., of Bellingham, Wash.

The company found it necessary to move this locomotive from one of their timber claims to another between which there was no connecting railroad. With the aid of a derrick the locomotive was lifted from its trucks, mounted upon the Garford tractor and the trailer and hauled over the rough forest roads to the scene of its future operations.

7½-Ton Service Wrecker

A Mack 7½-ton service wrecker similar to the ones used by the fire departments in many of the largest cities (New York, Boston, Cleveland, Baltimore, etc.) has been delivered to the West India Oil Company, Havana, Cuba.

This wrecker is equipped with a Meade-Morrison horizontal drum winch and collapsible derrick. The derrick



MACK 7½-TON SERVICE WRECKER OF TYPE OPERATED BY FIRE DEPARTMENTS OF NEW YORK, BOSTON, CLEVELAND, BALTIMORE AND OTHER CITIES.

is removable, and the truck body may be used to haul merchandise if necessary.

In use, the derrick extends back over the rear of the truck. It is capable of lifting the heaviest trucks bodily from the ground, and can tow disabled trucks on either front or rear wheels by raising the other end clear of the ground.

Under the rear of the body platform are two I-beams to support the weight of the derrick. Between the I-beams are two heavy 8 by 10 in. wood blocks, which, when the derrick is in use, rest on the ground and thus relieve the springs.

Portable Turntable for Motor Trucks

A portable turntable for motor trucks is the latest addition to contractors' equipment made by the McKiernan-Terry Drill Co. of New York. It is designed to be used in places where trucks are loaded or unloaded and there is not sufficient space to turn the truck in the ordinary way. It may be used in connection with a revolving steam shovel and for depositing materials on roads under construction. The turntable can be pulled along the subgrade by a steam shovel or a road roller without damaging the grade. It is anticipated that it will also find a place in material yards, docks and freight terminals.

A 2-Ton Diamond-T Truck and a Concrete Road

T. J. White, Jr., of Hales Corners, Wis., operates a 2-Ton Diamond-T truck in collecting milk from 44 farms and hauling it to Milwaukee. This hauling has been going on since April, 1917. The truck has travelled 27,000 miles since it was purchased. During the first six months Mr. White hauled over an earth road. Then a concrete road was built, which enabled him to cut in half the time spent in transportation, and reduced his operating

Get This Truck's Record Is All We Ask

We honestly believe that no business house, in its own interest, can afford to buy any truck withous fully informing itself about the Gramm-Bernstein.

It should know, for example, that there exists a distinct preference for this truck among experienced buyers.

It should know, also, that this preference—which, by the way, is enjoying a very healthy growth—is a perfectly logical development.

It should know that Gramm-Bernstein owners are genuinely satisfied.

Our owners will testify that a Gramm-Bernstein lasts literally for years.

That operating upkeep and repair costs are extraordinarily low—and especially so in ratio to the service the truck renders.

And that when they need another truck, or more trucks, their choice is invariably the Gramm-Bernstein.

These things are important to a prospective truck-buyer.

They are important to us, for they tend to confirm our belief that the Gramm-Bernstein represents the soundest truck engineering practice in America.

This belief is based on something more than a truck-building experience now rapidly approaching 20 years.

It is based on Gramm-Bernstein records and performance.

It is strengthened by the fact that Gramm-Bernstein features were adopted bodily for the Army's trucks, and that they had long before proved themselves practical and successful.

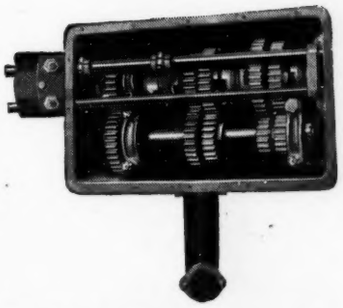
Gramm-Bernstein engineering finds its latest expression in our new 5-ton truck, which has already had a test equalling two years' ordinary travel of a 5-ton vehicle.

We ask no business to buy our trucks on our say-so—though that is a perfectly safe thing to do.

Gramm-Bernstein performance and service are matters of record. Any one of our dealers will place the facts before you, and put you in touch with our owners.

The most we ask is that you get the complete information.

Gramm-Bernstein Worm-Drive Trucks, in 1½, 2, 2½, 3½ and 5-ton capacities, are now sold completely equipped, ready for the body—not an extra to buy.



The Gramm-Bernstein transmission is completely trouble-proof. It is actually a basic superiority. Careless driving, hard work, cannot possibly harm it.

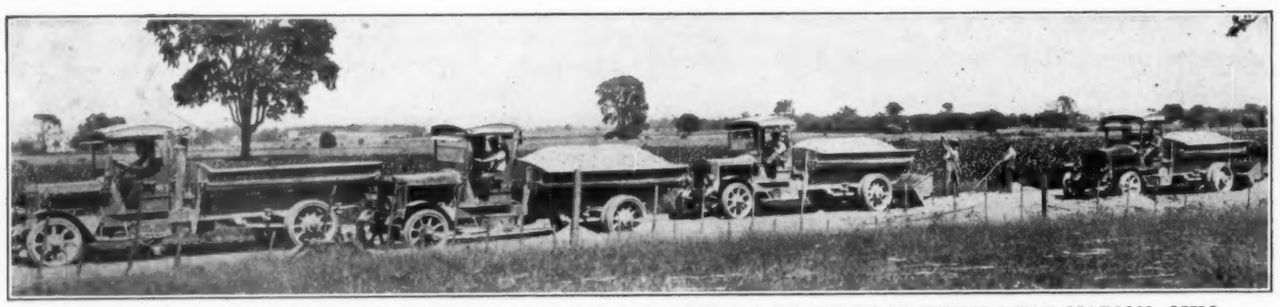
The gears are always in mesh. They are never shifted, never ground, never clashed. Speed changes are made through patented dog clutches.

Gears and clutches are progressively assembled on a heavy six-spline shaft and can never get out of alignment. Not a pin, bolt, nut, set-screw, stud or key, which might work loose, fall out, and possibly damage the entire gear set, is used in the gear assembly.

All Gramm-Bernstein Transmissions are provided with a pad for attaching Gramm's Basic Patent Power Take-off. Dealers and truck owners should assure themselves that any trucks purchased with power take-off do not infringe B. A. Gramm's Basic Patent No. 1194994.

The Gramm-Bernstein Motor Truck Co., Lima, Ohio, U.S.A.

Pioneers Since 1901—Builders of the First Liberty (U. S. A.) Truck



FLEET OF ACME DUMP TRUCKS AS OPERATED BY J. L. SEEDS & CO. ON ROAD WORK NEAR MARION, OHIO.

expenses 33 percent. The truck travels 12 miles on a gallon of gasoline. The milk is picked up at 7 a. m. and by 10 a. m. has been delivered to the dairy, pasteurized and made ready for distribution to consumers. All farmers pay the same rate to have their milk delivered.

A Fleet of 4 Acmes on Road Work

J. L. Seeds & Co. have been operating a fleet of four 5-ton Acme dump trucks on road work near Marion, Ohio. This fleet has been making eight trips, average haul about 7 miles, 14 miles to the round trip, working about 12 hours continuously, hauling 5½ to 6 tons, at $1.25 per ton. On the return trip the trucks pick up loads of sand for a contractor building a new asphalt pavement in the city of Marion, for which they receive $4.20 per load.

How Truck Drivers Can Help Maintain Good Roads

"Drivers can do as much, almost, for the maintenance of good roads as highway engineers," declares Alfred F. Masury, Chief Engineer of the International Motor Company, manufacturer of Mack trucks.

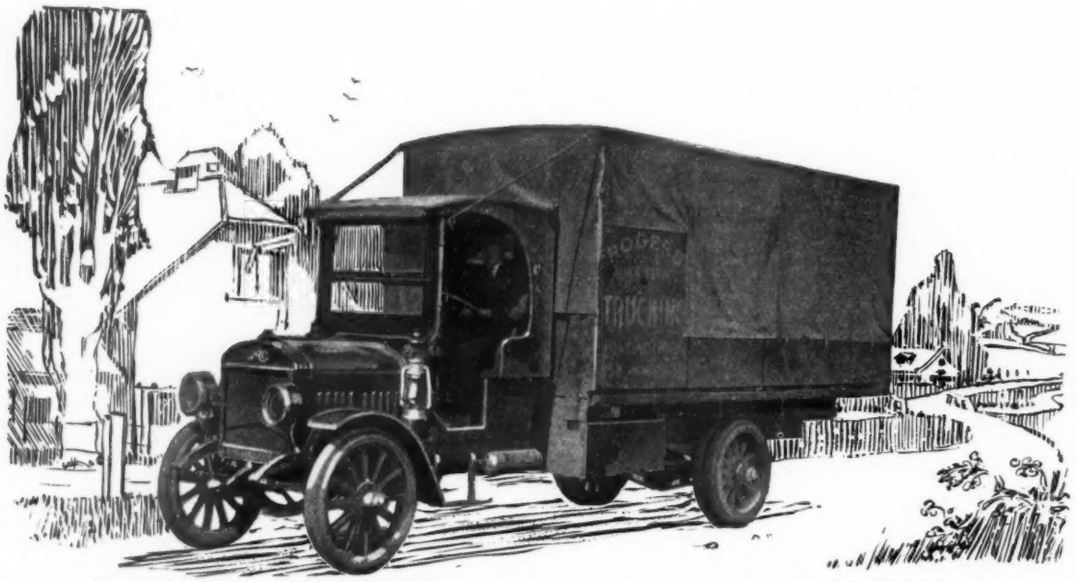
"Did you ever notice in going up a hill, particularly one paved with asphaltic concrete, that the surface on the right hand side of the road is wavy and rough, while that on the left hand side is smooth?

"The reason is this: The extra traction required to climb the hill wears and tears the surface, while there is little or no traction down hill.

"Another thing, the right hand track of the road in either direction is the one which is worn most. This is because of the arched surface of the road, which throws the greater weight and strain on the right hand side of the vehicle, and consequently the right hand side of the trackway. Truck builders and wagon makers have even adjusted their axles and springs so as to withstand the greater strain on the right hand side of the vehicle.

"The custom of arching the roadways was formed in the early days of road making, when dirt and porous-surfaced roads were the ones mostly in use, and it was necessary to give sufficient pitch to the surface of the roadway to drain off the water and prevent it from penetrating the surface of the road to soften and weaken the roadbed. With modern watertight surfaces the same necessity for arched roads does not exist, and engineers are designing roads with very slight pitch.

"Drivers can prevent wear to the surface of the roads and even improve their conditions if, instead of driving in one track or on the edge of the road, they will drive over the middle and other less used parts of the road when traffic permits. The one thing that is fatal above all things to road surfaces, whether dirt or paved, is driving in tracks, which subjects one small part of the road surface to all the traffic and damage that the whole road accommodates. Traffic should be evenly distributed over the entire surface of the road, and a little thoughtfulness and care in this respect on the part of drivers will do much to add to the permanence and excellence of our roadways."



G M C TRUCK AS OPERATED IN INTERCITY HAULAGE OF FEIGHT OVER THE HIGHWAYS OF MICHIGAN.

Building The Right Sized Trucks To Fit Each Transportation Requirement

By George A. Kissel

Experience has proven that a motor truck to be operated economically and efficiently must, above everything else, fit the purpose for which it is to be used. A misfit truck means not only high upkeep, but an investment that will prove a liability, because either too much ability will be expected or too little service will be realized. In the first instance, the overload will produce premature depreciation and big repair expense; in the second instance, you are paying for excess capacity not utilized.

Kissel "General Delivery" Model

The Results of Buying Adaptable Units

By purchasing truck units of the proper size and capacity for your requirements, the following advantages will result—

1—Lowest cost per ton mile.
2—Low gasoline and oil consumption.
3—Minimum wear on tires.
4—Maximum power at minimum expense.
5—Most efficient operation of all fixed or moving units.
6—Minimized wear and depreciation.
7—Big saving in time and labor.
8—Elimination of breaks or overstrain.
9—Lowest service expense.
10—Small capital invested in parts stock.

The fact that the Kissel Motor Car Company builds five different sized trucks, from the "General Delivery" ¾ to 1 ton to the "Goliath" 5-ton model, insures a truck for every purpose, a size for every business, and that is why fleet owners are standardizing their equipment with Kissel Trucks.

In other words—it is just as necessary to **standardize on the proper size model** as it is to standardize on one make. Therefore fleet owners realize that different sized models of the same make is the height of fleet efficiency and economy.

Way back in 1906 we realized the necessity of building the proper size trucks to fit the purpose for which they were purchased. To do this successfully our designers and engineers studied the different requirements each line of business would demand.

A Size for Every Purpose

No matter what transportation demands and problems you are up against, your nearest Kissel dealer can supply you with the proper size Kissel Truck that will economically and efficiently meet your transportation demands as if that truck were built to your own specifications.

"General Delivery" model, (capacity 2250 lbs. including body)—for **retailers** and **merchants** who want a quick delivery truck for speedy work in city and suburban districts—for **manufacturers** and **wholesalers** who want a light truck as auxiliary to their heavier models—for **farmers** who want a reliable light delivery truck equipped with a good loading space and ability to carry loads at a good rate of speed.

"General Utility" model, (capacity 4000 lbs. including body) **built for retail lumber, furniture, hardware, soft drinks, department and similar stores,** and delivery of **freight, farm products, dairy** and **milk products.** Adaptable for **passenger** and **depot** busses, **drayage** and **transfer** systems.

Kissel "General Utility" Model

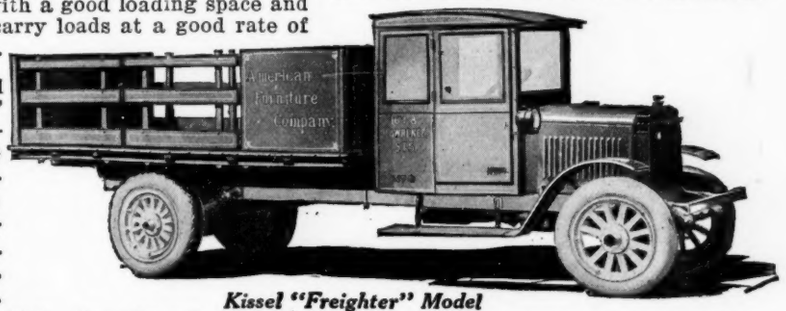
"Freighter" model (capacity 5200 lbs. including body)—the masterpiece of the 2-ton field that comes nearer in performance and ability to the 2-ton U. S. Army "A" truck than any other 2-ton truck on the market. The ideal truck for **transportation** and **express companies, rural motor express, roadbuilders, contractors, excavators, municipal work, farmers, manufacturers, wholesalers, coal** and **wood dealers,** etc.

"Heavy Duty" model (capacity 8600 lbs. including body)—for **contractors, road builders, express** and **moving companies** that specialize on heavy haulage; is particularly suitable for hauling of **lumber, stone, brick, machinery, gravel, cement, materials for street, sprinkling, flushing and oiling.**

"Goliath" model (capacity 11800 lbs. including body). A brute for **heavy work,** a giant in power and strength when **tons of dead weight** are to be transported and delivered short or long distances over all kinds of roads and up different grades—strong and capable for **any emergency or the heaviest load.**

Uninterrupted Transportation This Winter

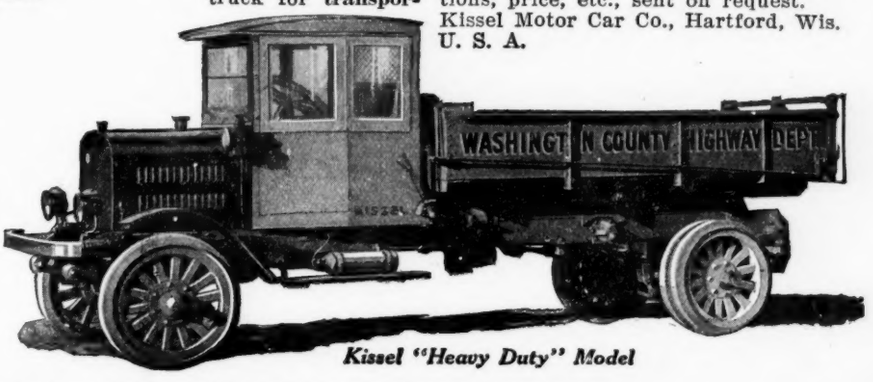
To insure Uninterrupted Transportation the year around, the ALL-YEAR Cab for Kissel Trucks was originated, perfected and patented. By adding the winter attachments—side door and window attachments, the open cab—standard equipment on the four largest Kissel models,—is quickly changed to an enclosed cab, warm, dry and comfortable—giving complete protection to drivers in the most severe winter weather—eliminating layups on account of storms and increasing efficiency of drivers.



Kissel "Freighter" Model

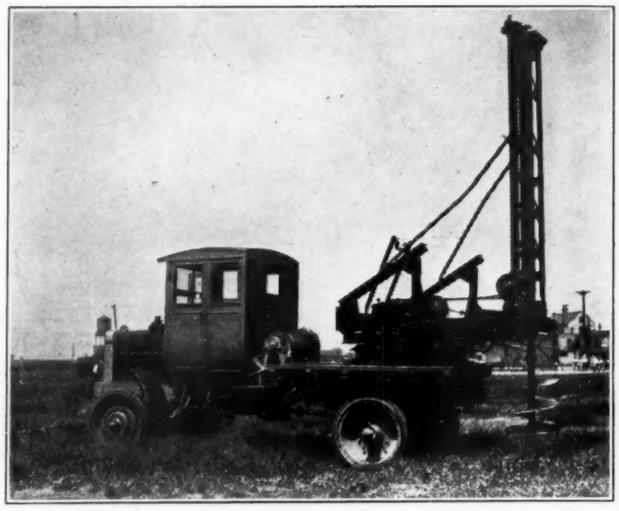
The nearest Kissel dealer will study your transportation requirements to insure your getting the right sized Kissel Truck, reducing your transportation expenses to the proper ratio of goods hauled and miles covered. Specifications, price, etc., sent on request.

Kissel Motor Car Co., Hartford, Wis.
U. S. A.



Kissel "Heavy Duty" Model

SERVICE 3½-TON ROAD BUILDING AND CONTRACTORS' SPECIAL MOTOR TRUCK WORKING ON AN ASPHALT PAVING JOB.



TELEGRAPH POLE HOLE BORING AND ERECTING OUTFIT BUILT FOR THE AMERICAN TELEGRAPH AND TELEPHONE COMPANY BY THE WINTHER MOTOR TRUCK CO.

Motor Truck Solves Its Own Fuel Problems

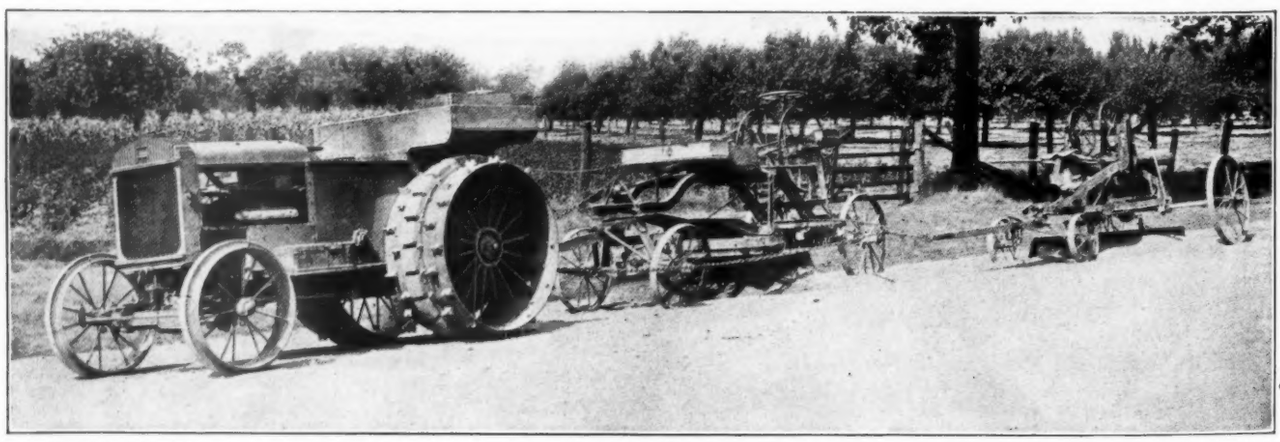
The immense problem of supplying the world with gasoline for use in automotive vehicles is best illustrated by the fact that there are over 6,000,000 motor vehicles in the United States today, and the demand is far outreaching the supply. The allied countries of Europe have 350,000 motor vehicles. In 1917, in the United States alone there was one motor vehicle to every 18 persons. These figures, compiled recently by the research department of the Federal Motor Truck Company of Detroit, Michigan, give a fair estimate of the immensity of the distribution problem in the oil and gasoline industry.

In the city of Chicago there is one motor vehicle to every 33 persons. Every one of these cars or trucks must have its ration of gasoline to enable it to make mileage. A minimum of 2 gals. of gasoline per day, which is very conservative, makes over 12,000,000 per day to be distributed. In addition to this the gasoline must be convenient to the motorist. It must be distributed from roadside stations from one end of the country to the other. In every big city there are thousands of oil stations—throughout the rural districts they are dotting the landscape and now even the "general store" at the cross roads has its gas station.

The problem of supplying gasoline to these stations has been successfully solved by the motor vehicle itself, it has worked out its own salvation. As an illustration of the immense organization and business equipment which is necessary to permit one to buy gasoline conveniently consider one convenient central oil distributing station in Chicago.

This station—the Standard Oil (Indiana) plant at 1350 South Leavitt street, Chicago, employs 150 men. Here more than 200 motor trucks are serviced, rebuilt, new bodies made for them and the whole organization works 24 hours per day to keep the trucks on the job—supplying gasoline to the wayside stations of this company in Chicago. With the system utilized by this company, this big plant is able instantly to repair a damaged truck; thus the truck is idle a minimum time and the gasoline is kept going into the motor vehicle's tank.

All this is done to supply Chicago with motor fuel. It is only a typical example of what is being done in every part of the United States. Upon its operation and



A "TRACTION MOTOR" (MUSKEGON, MICH.) PULLING TWO ROAD GRADERS AND GRADING ONE-HALF OF ROAD IN ONE OPERATION.

LEE LOADERS SAVE TIME IN TRUCKING FROM CARS.

efficiency depends to a certain extent, the low price of gasoline and the constant flow of gasoline which must meet the demands of our millions of motor vehicle owners.

Motor Trucks as Railroad Branches

"The attitude between the railroads and the motor truck is gradually turning from a spirit of competition to a spirit of cooperation," says R. E. Fulton, Vice President of the International Motor Company.

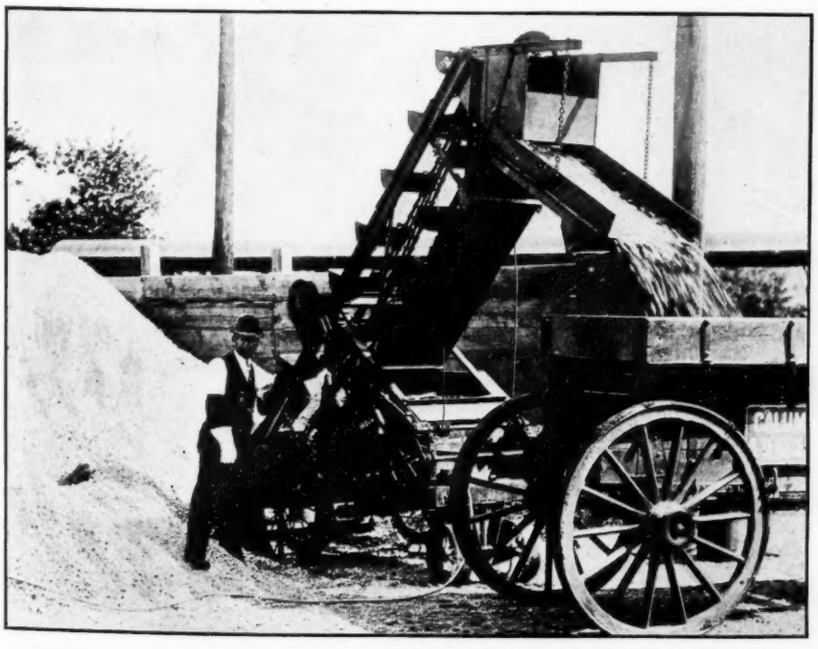
"The present serious financial condition of the railroads and the increased freight rates that will inevitably follow, together with the economic advantages of the motor truck, point to a very favorable effect on the prices of foodstuffs as a result of that cooperation.

"The use of trucks as feeders to the railroads up to a distance of 100 miles will release their facilities for the increasing tonnage that requires long distance haulage. It has been specifically proven that because of the duplication of handling in railroad transportation, goods can be shipped on short hauls more economically by motor truck. In a few years the truck will be the standard method of short distance hauling. By acting as a feeder within a radius of terminals it will provide the railroads with an increased tonnage and assist in making complete delivery, since it will penetrate areas that are now without transportation facilities.

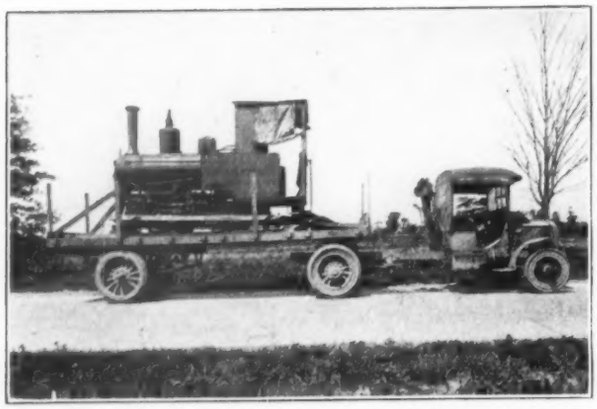
"The Big Four freight houses in Cincinnati have set the example. Two motor truck chassis and about ten bodies were used with tremendous success in relieving the railroads of a large tonnage of short haul traffic. Branch stations received the bodies which were filled and loaded on the chassis. On a fixed schedule they were brought to the terminals and their contents transferred to through cars. Under the old system cars had to be sent to each of the branch stations and brought to the terminal by the engine, seldom more than a quarter filled.

"The advantages of this plan over the old extravagant methods are so obvious that other large cities throughout the United States are realizing the tremendous potentialities of the truck as a feeder to the railroads, and are establishing similar systems.

"The time will come when each and every motor truck that operates within a 50-mile radius of large cities will



A PORTABLE LOADER HANDLING GRAVEL FROM GROUND STORAGE PILE.



MOVING A ROAD BUILDER'S LOCOMOTIVE IS AN EASY JOB FOR A PACKARD TRUCK.

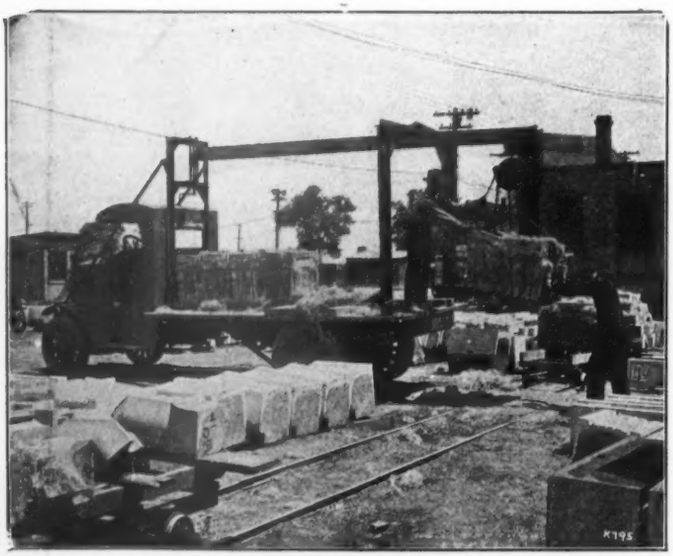
be in effect a branch line of a railroad. The reason for this is that a railroad requires an immense initial investment for right of way, grading, bridges and rails, and is limited in the amount of traffic it will hold. If such a branch line does not pay for itself, it cannot be diverted. On the other hand, a motor truck route has no limitations and can easily be transferred to a more profitable route if one does not prove successful.

"There is but one resistance to this transportation millennium and that is the lack of appreciation of the necessity for good roads. The sooner solid-built national highways are supported by legislation the sooner a great factor in the high cost of living will be reduced."

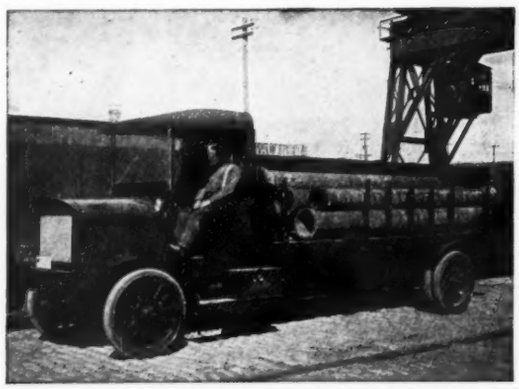
A New, Unsinkable Lusitania

Moving by truck from city to city has become so common, and this new trucking business has grown so tremendously that new and more complete equipment is demanded every day. One of the most complete moving-van trucks that has been manufactured was made recently by the Federal Motor Truck Company of Detroit, Michigan.

This truck, which is owned and was designed by T. F. Cathcart of Atlanta, Georgia, is probably the largest



MACK 5½-TON TRUCK WITH OVERHEAD LOADING TRACK AND CHAIN HOIST AS OPERATED BY HYDRO STONE PRODUCTS CO., CHICAGO.



KLEIBER 3½-TON TRUCK AS OPERATED BY THE PACIFIC GAS & ELECTRIC CO.

ever manufactured. It is 26½ ft. long and 11½ ft. high and has a loading space of 835 cu. ft. Unloaded, the truck itself weighs 11,050 lbs.

Its equipment is unusually complete. It carries electric lights throughout. It has a water cooler, front and side doors, which are locked with steel bolts, a driver's seat accommodating six and their luggage and locker for six lunch boxes. The double walls of this van are reinforced with steel and highly finished.

The transfer business always gives a motor truck hard service, and plenty of it—perhaps the most severe service of any business using light trucks. The bodies receive particularly rough service, and this special design by Mr. Cathcart is perhaps the most efficient body design for this purpose ever produced.

Because of its size and complete equipment Mr. Cathcart christened his truck the "Lusitania."

Operating Motor Trucks on Railroad Principles

In practically every section of the country motor truck transportation companies have been started and, taking them as a whole, are making good and proving to be sound financial investments for customers," says H. P. Branstetter, Chicago Kissel distributor.

"It has been found that merchants, wholesalers and manufacturers as well as farmers, orchardists and agriculturists are more than willing to help create transportation facilities in their neighborhood by patronizing those motor truck companies whose object is to give them reliable transportation schedules.

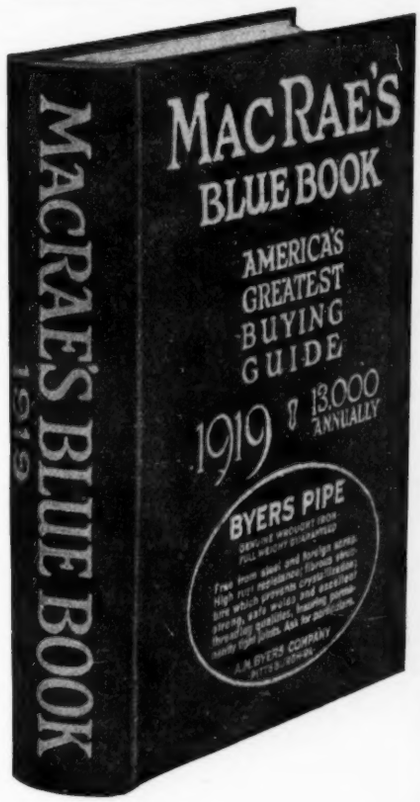
"There are several steps that must be taken before such motor truck transportation companies can get on an efficiency basis. One step is that of a thorough understanding of the adaptability and utility of the motor truck by owners and drivers alike. The railroads have the care and maintenance of their rolling stock down to a science. It is an important branch of operating railroads for men to see that the rolling stock is kept 100 percent efficient for continuous service. The same systems they use can be adopted with modifications, of course, to the maintenance of motor truck rolling stock.

"A second step is that of motor truck drivers and loaders becoming familiar with the operation of trucks. Just as the locomotive engineer has to work his way from flagman or switchman up through firing to the engineering post, so the motor truck driver should pursue a similar succession of steps in familiarizing himself with every detail.

MacRae's Blue Book

IS

America's Greatest BUYING GUIDE



BECAUSE it is the Buying Guide *of*—

Every officer of the United States Army, Navy and Corps of Engineers who buys or specifies government supplies.

Every large contractor or contracting engineer.

Every official of *every* steam or electric railroad in America who buys or specifies.

Every coal mine employing one hundred or more men, and *every* metal mine operating a stamp mill or concentrator.

Every ship, car and locomotive builder.

Every large agricultural implement manufacturer.

Every iron and steel mill.

Every important hardware jobber.

Every automobile manufacturer.

Every municipality in America of 20,000 or more inhabitants.

Every export agency dealing in Railway Supplies, Building Material, Lumber, Iron and Steel Products, Machinery, Automobiles and parts.

Every member National Metal Trades Association.

Every important jobber of electrical supplies.

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And over four thousand other large buyers of miscellaneous material and supplies in America and abroad.

More than 100,000 copies of MacRae's Blue Book have been issued, and it is estimated that more than 40,000 copies are in use today.

Representation for the 1920 edition is now being accepted. Let it be your silent salesman for the coming year.

MacRae's Blue Book

Railway Exchange **CHICAGO.**

"Such knowledge not only makes the operation of a motor truck a scientific matter, conducive to time and economizing records, but also makes the work easier for him. And it is a known fact that the average truck driver takes pride in the way he does his work.

"Other steps are those of motor truck owners and drivers forming organizations for the betterment of the business as a whole, the study of loading and unloading methods, interest and activity in Good Roads building

FLEET OF AUTOCAR DUMP TRUCKS OPERATED IN CONJUNCTION WITH A STEAM SHOVEL IN EXCAVATION FOR CONSTRUCTION OF A BUILDING.

and maintenance of the routes over which the motor trucks operate—the erection and maintenance of receiving and shipping stations and substations, laying out schedules and maintaining them with an accuracy that makes their schedules ones that can be depended upon.

"While I have only touched lightly upon the different steps the motor truck transportation company must take before emerging as a recognized business, it can be easily seen that such recognition is only a matter of time—that the present and future demands of transportation will make it necessary to operate on proven lines."

A Road System That Will Serve 87 Percent of the United States

It is possible to build a hard surfaced highway system of 50,000 miles so located as to serve directly 46 percent of all the counties of the United States and indirectly 41 percent of all the others. For an annual expenditure of $100,000,000—hardly one dollar a person per year—this fundamental road system could be completed in 12½ years, and it would serve 87 percent of the total population of the United States. Such is the statement of the United States Department of Labor.

"The growing needs of the country demand that some such comprehensive highway system be constructed," says R. E. Fulton, Vice President of the International Motor Company.

"In the past there has been too great a lack of foresight on the part of road builders. They have lacked vision to foresee the requirements of even five years ahead. A road built today must be built, not with the idea of present traffic, but that of ten years in the future.

"The growing need of the day is for transportation. We have simply got to provide it. We cannot stop it and the sentiment of the country will not tolerate any handicap of our transportation system.

"With each year the railroads are becoming more and more inadequate. Motor transportation is a growing economical necessity, a fact that is being recognized more and more each day as motor trucks are called upon to handle traffic that the railroads cannot accommodate.

"Estimates prepared by engineering authorities show that the United States could afford to spend $1,250,000,000 on a hard surfaced road system of 50,000 miles which would serve directly and indirectly 87 percent of the population of the entire country. Not only would such a system be an economic asset that would pay for itself many times over, but its construction would provide work for many thousands of people for a number of years, and in that respect alone would have a great business value to the country in general.

"War increases business to replace the great losses of destruction; but the development of a nation in times of peace provides a more normal and healthy market for labor and material that can be made a stabilizer of business and industrial conditions.

"A well planned national highway system is a necessity, and as soon as the nation can complete the plan conditions will force putting it into operation."

SAVE MONEY LABOR TIME

THIS IS WHAT

Heltzel "Lightning" Loader Skips

do in unloading material from open cars.

Are **YOU** paying for idle trucks and idle men? Keep your motor trucks moving and your men busy. One **Loader** will pay for itself on the first job.

Made in 1 cu. yd. and 1½ cu. yd. sizes.

Send for Catalog.

Heltzel Steel Form & Iron Co.

WARREN, OHIO.

...Three Letters and a Suggestion...

Mr. L. A. Gillett, State Highway Engineer of New Mexico, writes us on the relative economy of horse and motor haulage as follows:

"I have some figures on the operation of 26 trucks of various makes and used under widely different conditions, and the total cost per ton-mile, including depreciation, averages 29.8 cts. The lowest cost per ton-mile of any one of these trucks is 13 cts., and the highest is 46 cts. If you figure a horse-drawn vehicle against this rate at $10 per day, average 24 miles, half of which will be loaded and carrying a ton and a half load, the cost per ton-mile for horse haulage is 55½ cts."

These are instructive figures from New Mexico.

Turning now to the East for similar information we are told by the State Highway Department of an important state: "We have no information on this subject."

The Highway Commission of a very important Eastern state reports: "No such study has been made by anybody in this Commission."

We have no disposition to be critical of the gentlemen who have courteously answered our letters, but we beg leave to suggest that in view of the economy of motor haulage on highway work as observed in New Mexico, and elsewhere, all State Highway Departments should compile data on this subject. It is really surprising that one of the newest of the state highway departments should undertake this study in advance of the oldest of such organizations.

It is hoped that during the winter months, engineers in highway service will devote some time to the compilation and study of records, so as to determine the cost of transportation of materials by various means.

Readers are urged to submit for publication, for the information of all workers in this field, such facts and figures as they may have that relate to this subject.

MUNICIPAL AND COUNTY ENGINEERING
538 South Clark Street CHICAGO.

HAUL IT IN A HALL

AMERICAN TRUCKS ARE SUPREME

LEADERSHIP of the international truck industry centers in the United States, simply because American built trucks are standard of the world—representing incomparably better value, dollar for dollar, than any produced elsewhere on the face of the globe.

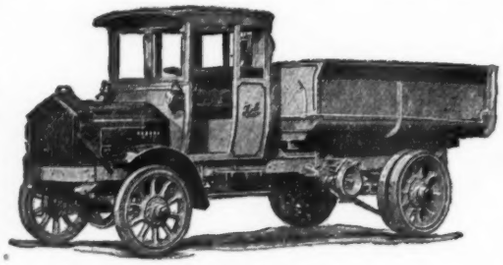
And, among America's many fine examples of heavy duty vehicles, **HALL TRUCKS** are, at least, equal to the best.

That's because **HALL TRUCKS** are the direct result—the definite physical answer to a great haulage problem, successfully worked out by **THE LEWIS-HALL IRON WORKS** organization in its own cartage interest.

An organization possessed of a daily knowledge and experience in the fabrication of metals—the basic material from which all trucks are made—dating back to 1873.

Each **HALL TRUCK** is the product of that knowledge and experience.

Each **HALL TRUCK** carries with it forty-six years manufacturing and business responsibility.



A Hall 5-7 Ton Truck

Naturally the conservation of that Good Will, built up during all those years, means that each HALL TRUCK is as good as money, material and master-metal-skilled-workmanship can make it.

Give the *Hall dealer* in your territory a chance to demonstrate the true service value of ***Hall Trucks,*** or, write us direct for descriptive literature and complete specifications of all models. *Address Sales Department, No. 19 Roby Street, Detroit, Michigan.*

As Manufactured by
The LEWIS-HALL IRON WORKS
DETROIT, MICHIGAN.

EDITORIALS

HE GETS RESULTS

So many public improvements of the first magnitude are being made in Chicago that it would be quite possible to write enough good articles about them to fill several issues of this magazine. Perhaps we have been neglectful of news opportunities close at hand. There are two reasons for this, now that we think of it. The first is that we assume that our readers, living in cities of all sizes in all parts of the country, are not greatly concerned about projects of exceptional importance in this great city, but much prefer articles dealing with problems of ordinary size and frequent occurrence. Then, too, we long ago resolved to be as different as possible from journals that fed their readers regularly with stories of the Catskill Aqueduct, the Hudson River Tubes, the Woolworth Building, etc., all of which are as remote from the problems of the average engineer as the design and construction of a planetary system of canals. The second reason for our neglect of these great local improvements is that we were reluctantly forced to conclude, some years ago, that these jobs would never get out of the prospective work department. The names of some projects became household words, but the works themselves seemed as far removed from the present generation as Fort Dearborn itself.

Now all this is changed. Chicago is doing things on a big scale again in the public improvement department. Many of these improvements undoubtedly possess dramatic interest of an exceptional order and quite possibly our readers would tolerate, if they did not entirely approve, descriptions of them. But the most dramatic features connected with these improvements are those of Michael J. Faherty, President of the Board of Local Improvements, known locally as "Mike."

When he entered his present office he found a quantity of plans and projects that dated back to more or less remote times. There was the Twelfth Street Widening project, the Boulevard Link project, etc. These projects had long been talked of but their arrival was always indefinitely delayed. Today the Twelfth Street widening is an accomplished fact and the Boulevard Link construction is well on its way and only yesterday, November 4, funds were voted to complete it. To Mr. Faherty must go the major portion of the credit for accomplishing these results.

How does he do it? We can not give a detailed answer to this question, but we suspect that his effectiveness as a public servant rests largely on his leonine courage and his ability to cut through or brush aside all manner of legal and other obstructions deliberately placed in his path. He is especially happy in the possession and in the exercise of a faculty for quickly acquiring private property for public uses at a fair price to all parties. He has the Homeric trait of taking what he requires. We do not want to give the impression that illegal methods are employed. The methods are not only legal but sometimes, it is said, extra-legal.

On November 4 the citizens of Chicago voted $28,600,000 in bonds to pay for the construction of six great public improvements in the city. It is reported as characteristic of Mr. Faherty that much of the preliminary office and survey work for the improvements on which the people voted "yes" this month, has been finished for months. On one great street extension project, involving the condemnation of property, he is now ready to go into court.

As soon as the result of the voting on these projects was known, Mr. Faherty issued the following statement:

> Now that we've got action, let's have it quick action. My advice to the property owners whose holdings will be affected by the improvements which the voters ordered is to lay off the lawyers and their promises to go shares with the owners on the loot they can get from damage suits. That stuff don't get you anything except a big supplemental assessment slapped on your property long after you think you've got something for nothing. In the long run we in the city hall will do better for you than those fifty-fifty lawyers can. The city expects us of the various equalizing boards to be fair and reasonable and decent with its citizens. We know the values and we don't want to gouge, and we won't be gouged. Not even a soap boiler is slick enough to put it over.

This statement is more eloquent than anything we could say. The saponaceous allusion in the concluding sentence is undoubtedly intended to apply to a laundry soap factory which for some time physically and otherwise obstructed the carrying out of the Boulevard Link plan.

Mr. Faherty is a most successful public works official. He understands the will of a majority of the people and, by successfully handling the obstructing minority, gets done what nearly everybody wants done. We believe he is appreciated by practically every class of people in this city. His methods are worthy of study by public works officials in other cities, especially in cities where a small minority of property holders obstruct progress year after year.

If we have bordered on the facetious at any point

in this expression of appreciation it must be charged to our exuberant enthusiasm over the work of this man. In all seriousness we regard Mr. Faherty as the most useful citizen Chicago has had since the passing of the giants of thirty years ago.

MARKING HIGHWAYS WITH NAME OF BUILDER

It has long been the custom in cities to require the builder of a concrete sidewalk to mark his name upon it in some permanent fashion. The reason for this requirement is undoubtedly sound. The writer of a letter is inclined to weigh his words carefully if he expects to sign his name to it. Works marked with the name of the builder will represent his best efforts.

There is considerable discussion now in California of a suggestion to mark highways with the names of the builders. It is argued in support of the suggestion that the public has a right to know the names of good as well as poor builders. It is proposed that a large sign be placed at the beginning of each contract section of the road marked so that the public will know who built the road, when it was built, and of what material it is made. At least two other names should appear on these signs: those of the engineer who designed the road and the one who supervised its construction.

Beyond a question of doubt this simple expedient would furnish the public not only a basis for intelligent criticism but would inevitably lead to the greatest degree of care in the selection and use of the materials of construction. If it should become necessary for individuals to defend themselves against criticism the engineering profession, as well as the public, might learn something worth knowing.

AN ADMIRABLE ANNUAL REPORT

To print and distribute an annual report within 30 days after the end of the year is an accomplishment much out of the ordinary in the public works field. The first thing to command our admiration of the thirteenth annual report of the Board of County Road Commissioners of Wayne County, Michigan, therefore, was the fact that we had our copy within a month from the end of the year covered by it. The earlier annual reports have been issued promptly, but this is such an exceptional happening as annual reports go that attention should be called to it.

The report is admirable, also, for what it contains and for what it omits. Undoubtedly many of our readers have seen the report, but for the sake of emphasis let us point out its strong features. It contains a large number of interesting and instructive half-tone illustrations. The text briefly describes the outstanding features of the year's work in maintenance as well as construction. The successful use of construction equipment is illustrated and described. Naturally the report contains some general and specific information about this world-famed system of concrete roads; just the information, doubtless, that is most frequently requested.

The report also possesses the charm of brevity as it consists of but 100 pages. If the best work done in a year by these commissioners can be described in a 100 page report there is little excuse for the bulky reports one frequently sees.

FOR A HORIZONTAL INCREASE

Having left off the actual practice of engineering while still a comparatively young man it is perhaps only natural that the editor should be something of a worker for the younger men in the profession. We have always felt that the earnings of the profession should be increased from the bottom up. Certainly we have never thought that increases should both begin and end with men in the lower grades, yet something of that kind is occasionally proposed. In some cases where salary increases have been recommended, it has been proposed that men in the lower grades be granted increases as high as seventy per cent. while those in the highest grades of the same organization are slated for increases of only ten per cent. or for no increase at all. We are unable to defend any such adjustment.

Granting that all salaries have been too low, what justification can there be for raising those at the bottom without correspondingly raising those at the top? We must have a starting point for any readjustment and the starting point in this case should be the level of salaries existing at the outbreak of the war. Unsatisfactory as those salaries may have been they were the only ones we had and we fear there would be much difficulty in agreeing upon a better starting point. Those salaries had been fixed by the practical application of the law of supply and demand for several decades, by individual salesmanship, by the salary expectations of engineers, by their willingness to work for the salaries offered, and by all other factors of whatever nature. We believe, therefore, that the old level of salaries is not only the best but the only base from which to operate in working for increases.

Now what we have said applies to all grades alike. The same factors, generally speaking, had fixed the compensation of engineers in all grades. These salaries may have been absolutely wrong but they were relatively right. It is not likely anyone would argue that the chief engineer was paid more than he was worth in comparison with the salaries paid draftsmen and instrument men. If the salaries were relatively right then they must be proportionately increased to remain relatively right. A straight horizontal percentage increase seems the logical readjustment to work for. What that percentage increase should be is another story, but if it is 50 per cent., then the chief engineer should get it as well as his minor assistants. This is not only justice but it is the very essence of expediency as well, for a movement calculated to benefit but a few cannot hope to gain the support of all.

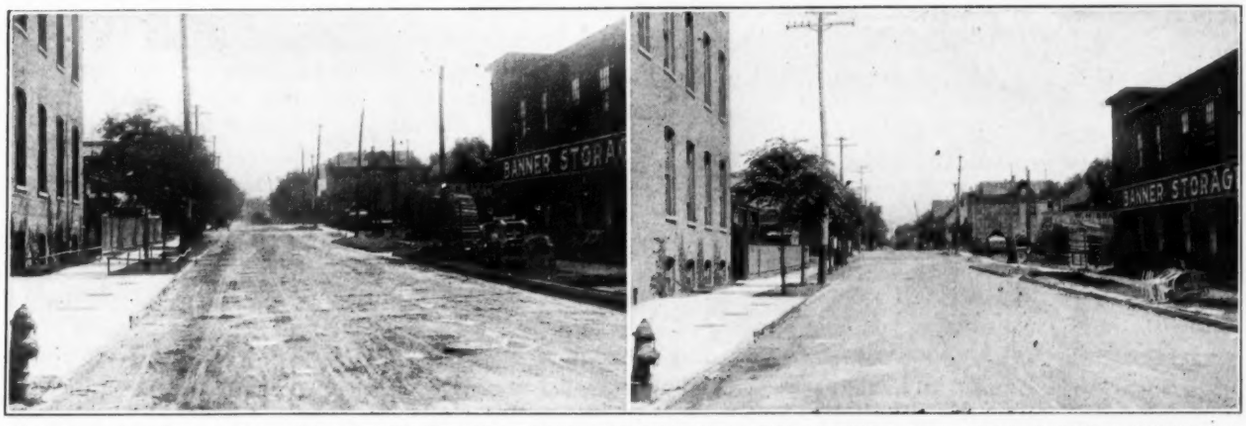
LARGER TYPE

A reader of this magazine recently suggested that the use of larger type in the editorial section would undoubtedly be appreciated by all our readers. In line with this suggestion the articles in this issue are set in 10 point type instead of in 8 point as formerly. Numerous readers have suggested from time to time that the headings of articles be made more prominent to facilitate the location of matter of greatest interest to the individual. The article heads in this issue have been set in capital letters instead of in capital and lower case as heretofore. These changes are made, therefore, in line with the suggestions of users of the magazine and we trust this will add to its usefulness.

RESURFACING OF OLD MACADAM STREETS IN MILWAUKEE

By C. J. Van Etta, Superintendent of Street Construction and Repair, Department of Public Works, City Hall, Milwaukee, Wis.

When the present Milwaukee city administration came into office in 1912 there was a total of 200 miles of water-bound macadam streets, and traffic conditions at that time rendered these streets impossible. The problem of maintaining this water-bound macadam was one which proved a puzzle to the Street Construction Department. For two or three years we attempted to resurface them with water-bound, but found that they would not hold up under traffic. We were compelled to go over the same streets year after year in order to keep them in any kind of a passable condition, which at the best, was not very good. We soon found that some other method would have to be resorted to in order to maintain these streets until such time as a permanent pavement, that is to say, a pavement with a concrete foundation could be constructed. After some experimenting we finally hit upon the plan of resurfacing with the penetration method, which we have found to be the only method that will hold our streets until such time as we could get to them to improve them permanently.



WALNUT STREET LOOKING EAST FROM 31ST STREET, MILWAUKEE, WIS., BEFORE AND AFTER RESURFACING OLD MACADAM WITH TARVIA X.

Cost of Resurfacing

Since 1915 we have averaged 200,000 sq. yds. per season with this penetration work, at a cost as low as 55c per square yard and ranging to the present season at 70c per square yard. This includes the entire cost of the work, both the labor and material for the base and also the tar application and the labor and the material in connection with the surface. This method of resurfacing has worked out so successful that up to date we have had absolutely no maintenance cost—up to this time have not found it necessary to tear up any of these streets for the purpose of constructing a permanent pavement. This, I think, is an excellent recommendation for this method, for I can say that it certainly has been a "life-saver" to this city where such a great amount of water-bound macadam existed.

The Method Employed

The method that we use for this resurface work is as follows:

The surface of the old road, after being cleaned of all loose dirt and foreign material, is spiked up or scarified. The road surface is re-shaped, made smooth conforming with the grade, but 2½ ins. below the finished grade, and rolled until firm and hard.

The roller used is a power roller of a type suitable for macadam road construction and weighs 10 to 15 tons.

The stone is of best quality crushed rock (or other approved road material metal) free from dust, loam and clay.

If, after re-shaping, the surface of the road is more than 2½ ins. below the finished grade, it is brought up to the required grade with crushed stone of a suitable size. The added stone is filled thoroughly with sharp sand, gravel, stone screenings or similar filler approved by the engineer, and rolled until smooth and firm. No filler shall be left on the surface.

The wearing course is placed over the base thus prepared and consists of a layer of stone which passes a 2¼ in. ring and is retained on a 1¼ in. ring, spread to a finished depth of not less than 2½ ins. This course is not filled but is keyed thoroughly together by rolling. The surface is left smooth and of even, firm texture, clean and free from dirt, clay, stone dust or other material which will prevent the easy penetration of the Tarvia X.

Tarvia X Employed

Tarvia X, heated to a temperature of not less than 200 degrees F. and not more than 275 degrees F. is spread uniformly over the surface when dry to the amount of not less than 1 7-10 gals., nor more than 1 8-10 gals. to a square yard.

Three-quarter inch crushed stone without dust, i. e., stone which passes a 1¼ in. ring and is retained on a ½ in. ring, is spread over the surface, filling the voids, but leaving none on the surface. This course is then rolled until firm.

The road is swept free from any particles of stone not held by the Tariva X. Not less than ½ nor more than ¾ of a gallon of Tarvia X to the square yard, heated to a temperature of not less than 200 degrees F. nor more than 275 degrees F. is spread over the surface and covered with stone screenings or sharp sand. The road is then rolled until compacted. A sufficient amount of screenings or sand is left on the surface to protect the road while setting up.

How the Work is Handled

When we first took up this work we handled the tar mixture with our own forces but this did not work out very successfully, owing to the fact that we handled it from tank cars which had to be heated and loaded into tank wagons and hauled to the street and applied under pressure, by hand. For the last two or three seasons we have been buying tar applied—the company furnishing it having their own equipment and their own forces to handle it. I find that this can be done cheaper and more effectively than the old method, as we have absolutely no concern about the applying of the hot tar as heretofore.

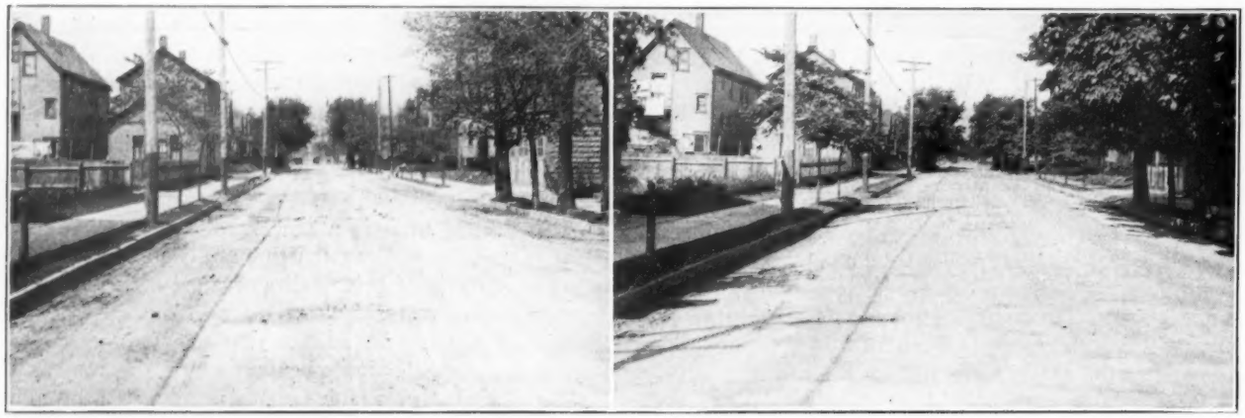
I would recommend, where this work is carried on, that a limestone be used if possible although a good heavy crushed gravel will answer. I am probably more partial to limestone owing to the excellent grade we are able to procure within a very short distance from the city, since we have three or four quarries within a radius of from 2 to 12 miles. I believe that limestone is superior to the crushed gravel owing to its absorption qualities, which you do not get in a hard crushed gravel.

I have received a great number of inquiries regarding our method of handling this work from various parts of the United States and Canada, and do not hesitate to recommend this method for residential sections for the larger cities and also streets of the smaller towns, where this type of surface would hold for years owing to the light traffic conditions.

Tarvia "K. P." Successfully Employed

In connection with this work I have found that where plumber's cuts and other cuts were made in streets, that had been resurfaced with this method that the new "K. P." mixture is an excellent material for replacing the surface. This can be mixed cold and if necessary, stocked and used anywhere from one to six weeks after it has been mixed or can be mixed by hand on the job, to be used to replace the penetration surface.

This mixture is certainly a wonderful thing in my opinion because of the simple manner in which it can be mixed and applied. It should be well rolled or thoroughly tamped in order to close up the surface as much as possible and to consolidate the mix.



LOCUST STREET LOOKING WEST FROM EIGHTH STREET, MILWAUKEE, WIS., BEFORE AND AFTER RESURFACING OLD MACADAM WITH TARVIA X.

We have been able to use this mixture, not only where there has been a penetration resurface, but have also used it for filling in on old brick streets, stone pavements, etc., where it holds up wonderfully well.

ROAD IMPACT TESTS

Test of impact delivered by various types of motor trucks on the road have been continued by the Bureau of Public Roads during the past few months with a 1½ ton truck, Class B Army truck, 5½ ton truck, equipped with solid tires.

The maximum impact pressure obtained with the 5½ ton truck was about 29,000 lbs. at 13 miles per hour, the wheel falling from a height of 2 ins. The truck carried 7.78 tons load. With a load of 5.65 tons, however, and under corresponding conditions of speed and drop, the pressure exerted was about 22,000 lbs.

With a Class B Army truck, carrying a total load of 7,750 lbs. on one rear wheel and having an unsprung weight of 1,837 lbs. on one rear wheel, speed 13 miles per hour, height of drop 2 ins., the impact was about 34,000 lbs.

Using another type of truck with a rear wheel load of 8,060 lbs., and with an unsprung weight of only 1,000 lbs. on the rear wheel, using the same conditions of impact as above, the impact pressure produced was only

about 22,000 lbs., which is approximately 65 percent of the impact produced by the Class B truck.

It will be noted that the unsprung weight of the last truck is only about 56 percent of that of the Army truck. The indications are that the unsprung weight plays an important part in the impact delivered to the road.

Under corresponding conditions of impact as stated above a 1½ ton truck with a total weight on one rear wheel of 3,470 lbs. and unsprung weight of 1,065 lbs., delivered an impact pressure of about 13,000 lbs.

The fact that the 1½ ton truck having an unsprung weight approximately equal to that of the 5½ ton truck exerted less impact than a 5½ ton truck, but it seemed to show that the unsprung weight is not the only factor to be considered in connection with impacts delivered to roads. The total weight on the rear wheel must likewise be taken into consideration.

Tests to determine effect of impacts on road surfaces are just about to begin. A trial has been made with an impact testing device and certain imperfections corrected. It is expected that very soon a number of tests will be made.

UTILIZATION OF OLD CONCRETE PAVEMENTS AS FOUNDATIONS

By Arthur H. Blanchard, M. Am. Soc. C. E., Professor of Highway Engineering, University of Michigan, and Consulting Highway Engineer, Ann Arbor, Mich.

No material created by natural or artificial processes, when subjected to the forces of nature and vehicular traffic, will last indefinitely. This axiom, as applied to paving materials, is accepted by progressive highway engineers. The belief, in some quarters, that certain types of pavements, constructed today, will be in perfect condition in the days of our grandchildren's grandchildren is being relegated to the proverbial closet containing the family skeleton (see Fig. 1).

Cement-concrete pavements have been used in the United States for 25 years. Today the cement-concrete pavement is being employed by many state and county highway departments, in conjunction with brick, bituminous concrete and stone block pavements, for the improvement of trunk highways. Municipal highway officials are likewise using the above types of paving in addition to others suitable for municipal work.

Utilization of Cement Concrete Pavements

It is apparent that the time has arrived when there should be a general recognition of the fundamental economic principles underlying the utilization of the cement-concrete pavement. This discussion will be devoted to the consideration of the cement-concrete pavement in its dual capacity of serving, first, as a wearing course directly subjected to traffic, and, second, as a foundation for a new wearing course such as a brick, bituminous, wood block or stone block pavement. Cement-concrete, as a resurfacing material, has purposely been omitted from the above general classification, as its utilization in this manner is, as yet, in an experimental stage, considered from the standpoint of economics.

In discussing the dual capacity of cement-concrete pavements, Lt.-Col. W. W. Crosby, formerly Chief Engineer, Maryland Roads Commission, states on page 1155, American Highway Engineers' Handbook: "When the ordinary concrete roadway surface begins to need repair it is practically only a question of a short time when the concrete surfacing will have to be abandoned as such, and turned into a concrete foundation because of the difficulties of repairing the concrete so as to leave it satisfactory as a road surface. The difficulties of proper repair are so well recognized that many engineers are now recommending such work to be done with bituminous concrete instead of cement-concrete, but of course this is only a step toward the ultimate transformation of the concrete roadway into a concrete foundation."

Need for Good Construction

The durability of properly constructed cement-concrete pavements, under different amounts and kinds of traffic, is a matter of conjecture within certain limits. The writer has seen cement-concrete pavements in an unsatisfactory condition, from the standpoint of serviceability, within two years after they were built. For example, the average cement-concrete pavement built by the State Highway Department of New York prior to 1914 had a short life due primarily to poor specifications, inexperienced

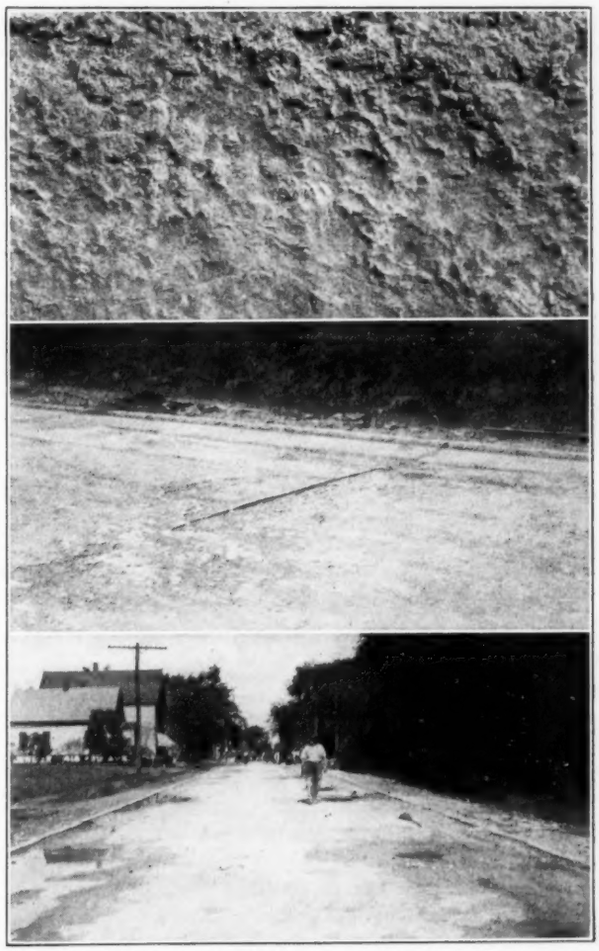


FIG. 1. TYPICAL SURFACE VIEW OF DISINTEGRATED CEMENT CONCRETE PAVEMENT.

FIG. 2. WORN OUT CEMENT CONCRETE PAVEMENT ON KILBOURN ROAD, MILWAUKEE COUNTY, WIS.

FIG. 3. OLD CEMENT CONCRETE PAVEMENT WIDENED FOR USE AS FOUNDATION FOR ASPHALTIC CONCRETE ON KILBOURN ROAD, MILWAUKEE COUNTY, WIS.

contractors, and low paid, inefficient inspectors. On the other hand, cement-concrete pavements, built in accordance with methods recommended by the National Conference on Concrete Road Building, the American Concrete Institute, the Portland Cement Association, Wayne County or Sioux City, have a life much longer in duration than the sad case heretofore mentioned. Recognizing the fact that inexperienced highway officials, contractors and inspectors are responsible for the construction of many poor pavements of types inherently good, the writer,

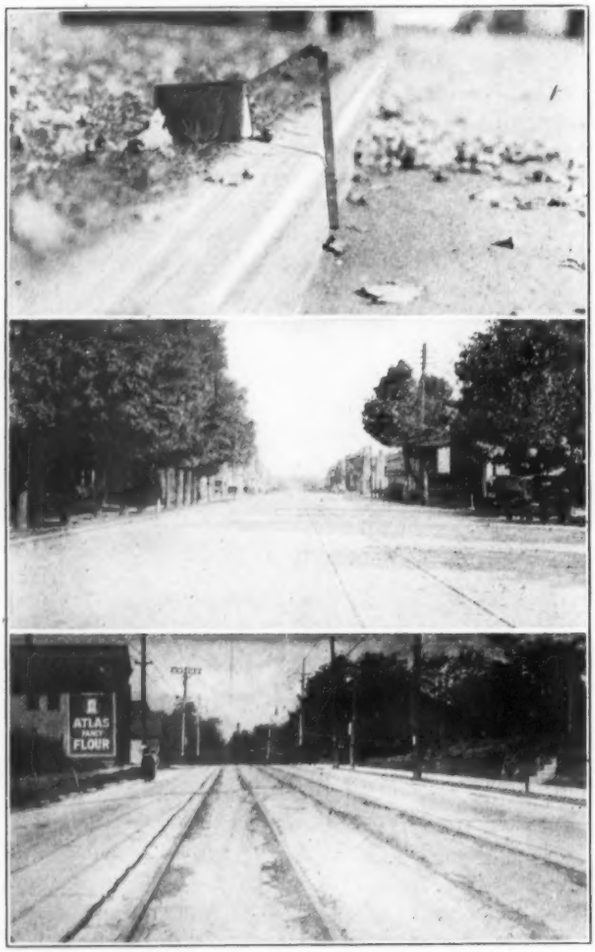


FIG. 4. FIVE INCH CURB ON STREET PAVED WITH CEMENT CONCRETE.
FIG. 5. SINGLE CAR TRACK ON STREET PAVED WITH CEMENT CONCRETE.
FIG. 6. DOUBLE CAR TRACKS ON STREET PAVED WITH CEMENT CONCRETE.

while consulting engineer in 1916 to a county just starting out on a reconstruction problem, recommended the use of cement-concrete, as one type for trunk highways, provided that the engineering staff of the Portland Cement Association would instruct the contractors in the proper methods of building cement-concrete pavements.

Engineers who have used cement-concrete pavements for years place their life, under trunk highway traffic, at between 8 and 15 years. Two examples will be cited. The cement-concrete pavement on Kilbourn Road, built by the Milwaukee County Highway Commission in 1913, had a life of six years and was utilized in 1919 as a foundation for a wearing course of asphaltic concrete (see Figs. 2 and 3). In 1910 a cement-concrete pavement was constructed on Grand River Road by the Wayne County Road Commissioners. In 1916 this road was resurfaced, as an experiment, with 3 ins. of cement-concrete. The Commissioners state that "Grand River Road was selected for this experiment because we felt that it would receive the severest kind of test, on account of the heavy mixed traffic which uses this highway, and because the section selected was rough and uneven."

The highway official or engineer who is responsible for the economic expenditure of public funds on highway improvements should look ahead and build for the future. As it is self-evident and generally admitted by broad-gauge engineers that the cement-concrete pavement will wear out within the first or second decade after it is constructed, the question naturally arises as to what will be done with the pavement when it reaches such a condition that its economic usefulness as a wearing course is at an end. Engineers, who have a proper appreciation of the public interests with which they have been entrusted, expect to use the worn-out concrete pavement as a foundation for a new wearing course.

Dual Capacity of Cement-Concrete Roads

The consideration of the dual capacity of the cement-concrete pavements will be dwelt with from three viewpoints: First, a road without the pavement adjoining a car rail; second, a curbed street without car tracks; and third, a road or street with the pavement built flush with the car track rails.

On Highways Without Car Tracks

On highways without car tracks and outside of urban districts, it is generally practicable, from a construction standpoint, to use a worn out concrete pavement as a foundation. Of course, cement-concrete or other suitable headers should be constructed and the shoulders must be raised and, in some cases, widened. The Maryland State Roads Commission has resurfaced in 1919 two worn out cement-concrete pavements, one built in 1913 and the other in 1914, with asphaltic wearing courses. Mr. J. N. Mackall, Chief Engineer, states that "both of the cement-concrete roads described have reached the end of their life, as such. They show a number of cracks, and are disintegrating. We have tried patching cement-concrete without success, and are now covering them with a 1½-in. binder course and 1½-in. topping course of asphalt."

On Streets With Curbs at Established Grades

On streets with curbs at established grades the problem may be unnecessarily complicated. Many municipal officials unfortunately have not looked ahead and considered the conditions with which they will be confronted when their cement-concrete pavements wear out. For example, an investigation of practice in many municipalities reveals the fact that cement-concrete pavements have been constructed between curbs where the clear curb depth is 5 ins. (see Fig. 4), the depth which local conditions require as a minimum. The construction of a wearing course on the worn out concrete pavement will reduce the desirable minimum depth to from 3 ins. to 1 in., dependent upon the type of new wearing course. It is self-evident that the use of any type of bituminous pavement will allow the curb depth to be cut down the least amount, and hence this type is being considered by many engi-

neers as the most desirable form of resurfacing. In order to provide for a new surface, when 5 or 6 in. curb depths are encountered, it will be apparent that the curbs must be reset, which not only entails unnecessary expense, but this procedure may also be impracticable from the standpoint of abutting property. The obvious solution is to construct the cement-concrete pavement at an elevation or grade which will provide a curb depth of at least 7 ins. under conditions where the curb depth should be not less than 5 ins.

For example, the wise policy of the City Engineer of Springfield, Mass., will be mentioned: "The city recognized as its problem the construction of a pavement which would not only carry successfully all present traffic, but which, at some time in the future, could be utilized in connection with the development of the road into a city street, as the city was building up rapidly in this direction. The roadway was laid with concrete pavement, the top surface of which was made parallel to and 2 ins. below the middle 22 ft. of the surface elevation proposed for the street pavement in the final development. When the growth of the city out this road may make it desirable to reconstruct it as a street the present concrete roadway will be widened by 12 ft. on each side, and the whole will then be used as a concrete base and covered with a 2-in. layer of stone-filled asphalt. The present pavement is 6½ ins. thick, which will be ample for a foundation for such a wearing surface, even though it may have lost ½ in. or so of material by wear in the meantime."

Where Pavement is Flush with Car Track Rails

The acme of unfortunate and uneconomical practice is reached when the construction of a cement-concrete pavement flush with the rails of car tracks is encountered (see Figs. 5 and 6). From the standpoint of conservation, a railway company should not be required to pay for the construction of its tracks to a new grade after it has once built its tracks to a grade established by the state, county, town or municipality. Many municipal franchises require that only the cost of construction to one established grade shall be paid by the railway company. In case a cement-concrete pavement, flush with the rails, is worn out and it is desired to use it as a foundation for a new wearing course, it will be necessary to raise the tracks and, in many cases, the expense incurred must be met by the municipality. The cost of this reconstruction is prohibitive from an economic standpoint. If, however, the old concrete pavement is not used as a foundation, usually the only satisfactory solution will be to tear up the worn out pavement. Milwaukee County, Wisconsin, has recently had this experience and, after an unsuccessful attempt to make the railway company raise its tracks from the established grade to a new grade, has broken up its worn out concrete pavement and thus thrown away the original investment. Future practice should conform to the rule that a cement-concrete pavement should never be constructed on roadways where the pavement must be built flush with the rails and the track areas form an integral part of the roadway surface subjected to vehicular traffic.

THE CONSTRUCTION OF PORTLAND CEMENT CONCRETE PAVEMENT FOUNDATIONS (CORRECTION)

Readers are requested to note a correction to the article of the above title as published on pages 169 to 171 of the October issue. As first set up the captions for the three cuts were in the wrong size of type. They were reset in the proper size and were then transposed before being inserted. Thus the captions as printed should have been inserted as follows: Figs. 3 and 4 under the first cut in the article; Figs. 5 and 6 under the second cut; and Figs. 1 and 2 under the third cut. The error was purely mechanical and was in no way the fault of the author of the article. Newspaper readers, familiar with the transposed line, probably had no difficulty in mentally transposing these captions to their obviously proper positions.

MORE ENGINEERING ON SEWER INLETS

The article entitled "More Engineering on Sewer Inlets," contributed to the October number of Municipal and County Engineering by Mr. W. W. Horner, Chief Engineer, Sewers and Paving, St. Louis, Mo., was much appreciated by engineers in various cities, as letters to the editor have demonstrated. Extracts from some of the letters received follow:

To the Editor:

I was interested in the article in the October number of your journal, entitled "More Engineering on Sewer Inlets." Mr. W. W. Horner, Chief Engineer of Sewers and Paving, of St. Louis, makes a valuable contribution to the profession in his tests and the conclusions he draws from them. This is particularly true in cities where streets have steep gradients and water is apt to collect in the lower stretches of the street because of inadequate inlets to the sewers.

This condition does not obtain in Chicago, as the streets are practically level and the sewer inlets are frequent. The inlets are usually horizontal grates and unless obstructed by leaves or other refuse will take the water and discharge it into the sewers more rapidly than the sewers themselves can carry it away.

Very truly yours,

C. D. Hill,
Engineer, Board of Local Improvements,
Chicago, Ill.

To the Editor:

I feel that this study on storm water inlets will be very beneficial to engineers and will give them some idea of the amount of water which can enter the inlet. The standard inlet which we use in this city is 2 ft. wide and 6 ins. high, and we endeavor to place them close enough so that no inlet will receive more than 1 cu. ft. per second.

Very truly yours,

W. J. Weaver,
Engineer in Charge Sewer Construction,
Columbus, Ohio.

To the Editor:

It is a pleasure to receive Municipal and County Engi-

neering. I found the article by Mr. Horner in the October number very enlightening. By coincidence, when this number was received, it so happened that I was reading three or four articles written by Mr. Horner in 1914 pertaining to the Mill Creek sewer in St. Louis. Contributions from Mr. Horner are of real benefit to anybody concerned in the design of sewerage systems.

Very truly yours,
W. H. Ohmen, Asst. Engineer,
Department of Public Works,
San Francisco, Calif.

Walter G. Turley, City Engineer of Sante Fe, New Mexico, writes: "Mr. Horner's investigation fills a want in the literature of the profession, and I appreciate his efforts and results."

A CONCRETE ROAD

The accompanying picture tells its own story. We publish it not so much for its news value as for its beauty. We present this view of a North Carolina highway as an eye tonic.

The view does serve to illustrate the quality of the highways in Guilford County, N. C. It shows a part of the road that won first prize in the Glidden Tour from New York to Atlanta. This road connects Greensboro and High Point. It is 16 miles long and the people of Guilford County hold to the opinion that there is not a better road in the United States. Disinterested observers have called it one of the finest pieces of county highway in the nation. For this handsome picture we are indebted to C. M. Vanstory, President of the North Carolina Automobile Association, to Mr. G. Daniels, Secretary of the Greensboro Chamber of Commerce and to the Roberts Film Co. of Greensboro.

VIEW ON 16 MILE CONCRETE HIGHWAY CONNECTING GREENSBORO AND HIGH POINT, NORTH CAROLINA.

PROPOSED SCHEDULE OF SALARIES FOR ENGINEERS IN STATE HIGHWAY SERVICE

The Committee of the American Association of Engineers on Salaries of Engineers in Public Service invites discussion of the accompanying proposed schedule for engineers in state highway service before presenting it to the Association for final adoption.

In appointing the committee last June the Board of Directors gave it authority to add to its personnel, with the approval of the President, representatives of the several branches of public service engineers in order that the schedules as finally adopted should not only harmonize with reference to each other, but that they should be generally accepted as stating the value of engineering service to the public, hence what it should pay for such service. In discussing the schedules sent out from time to time engineers should therefore bear in mind that the endeavor of the committee is not to standardize and classify engineering service, but to price this service.

The Committee on Salaries of Engineers in Public Service consists of S. C. Hadden, Editor of "Municipal and County Engineering"; H. G. Shirley, Secretary Highways Industries Association, Washington, D. C.; J. H. Prior, Consulting Engineer on Public Utilities, Chicago; A. R. Hirst, State Highway Engineer, Wisconsin; F. H. Newell, President of the Association, and A. N. Johnson, Chairman, Consulting Highway Engineer of the Portland Cement Association.

Preliminary to drafting the schedule for highway engineers, the following were invited to serve as correspond-ing members of the committee: Thos. H. McDonald, Chief of U. S. Bureau of Public Roads; W. L. Basset, Bureau of Municipal Research, New York; Col. W. D. Uhler, Chief Engineer, Pennsylvania State Department; A. B. Fletcher, State Highway Engineer of California; A. W. Dean, Chief Engineer, Massachusetts Highway Comission, and Clifford Older, Chief Engineer Illinois State Highway Department.

It is to be realized that the accompanying schedule is not an outline of organization. But in order that each state organization may readily place each person within it, it has been thought best to enumerate in considerable detail the description of the various positions even at the expense of some apparent repetition. The grouping of various positions is clear from the captions.

The proposed schedule follows:

ADMINISTRATIVE AND EXECUTIVE POSITIONS

Chief Engineer—		
In charge of all construction and maintenance work of the department, acting as chief executive officer	$8,000	$15,000

Engineer of Construction— In immediate charge of all construction work from time contracts are let. Assigned to state headquarters	6,000	10,000
Engineer of Maintenance— In charge of all maintenance work. Assigned to state headquarters	6,000	10,000
Engineer of Bridges— In charge of preparation of specifications and designs for bridges, and in charge of construction of special bridges. Assigned to state headquarters	5,000	8,000
Office Engineer— In general charge of preparation of plans and specifications for all construction work up to point of letting contracts. Assigned to state headquarters	5,000	8,000
Engineer of Tests— In general charge of laboratory routine tests, investigations, material surveys and field inspection of materials	4,000	7,000
District Engineer— In charge of all construction and maintenance work in a division or district of the state, generally including a number of counties. Assigned to division headquarters	5,000	8,000
ENGINEERING POSITIONS INVOLVING SOME ADMINISTRATIVE DUTIES IN THE HIGHER GRADES		
Advisory and Consulting Engineer— To the Chief Engineer	$5,000	$10,000
First Assistant Engineer— Assigned to Construction Engineer at state headquarters. In general charge of office work in connection with execution of contracts	3,600	5,000
First Assistant Engineer— Assigned to Maintenance Engineer at state headquarters. In general charge of office work in connection with maintenance	3,600	5,000
First Assistant Bridge Engineer— Assigned to Engineer of Bridges at state headquarters. In charge of bridge drafting room and responsible for bridge specifications and bridge designs	3,600	5,000
First Assistant Engineer— Assigned to Division Headquarters. In general charge of division headquarters office	3,600	5,000
Assistant Engineers— Assigned to Construction Engineer at state headquarters. Duties as assigned	2,400	4,000
Assistant Engineers— Assigned to Maintenance Engineer at state headquarters. Duties as assigned	2,400	4,000
Assistant Engineers— Assigned to Bridge Engineer at state headquarters. Acting as especially skilled draftsmen, designers and computers	2,400	4,000
Assistant Engineers— Assigned to Office Engineer at state headquarters. Preparing and checking specifications and plans as received from division offices. Work as assigned	2,400	4,000
Chief Chemist— Assigned to Engineer of Tests at state headquarters. In charge of the chemical work of the laboratory	3,500	5,000
Assistant Engineers— Assigned to division headquarters. Some in charge of construction, others in charge of maintenance, both field and office work as assigned	2,400	4,000
Assistant Engineers— Assigned to laboratory work. Tests and investigations in laboratory, field examinations and reports on sources of materials as assigned	2,400	4,000
Assistant Chemists— Assigned to laboratory	2,000	4,000
Chief Draftsmen— Assigned to division headquarters. In charge of division headquarters drafting room and the preparation of plans	2,400	4,000
Chiefs of Survey Parties— In charge of surveys and relocations; during time spent in office, work on plans and computations as assigned	2,400	4,000
INSPECTION SERVICE		
Confidential Inspectors— Assigned to Chief Engineer. Report only to Chief Engineer on work of all character wherever it may be. Positions of peculiar responsibilities, represent the chief engineer.	4,000	5,000
General Inspectors of Maintenance— Assigned to state headquarters	2,400	4,000
Inspectors of Bridge Construction— Assigned to Bridge Engineer at state headquarters. Inspecting construction of the larger bridges only. Work inside on bridge plans and design as assigned	2,400	4,000
Field Inspector of Materials— Assigned to Engineer of Tests at state headquarters. Inspection of materials in the field and at point of manufacture	2,400	4,000
Inspectors of Construction— Assigned to Division Engineers at division headquarters. Inspect construction reporting to division engineers or a number of inspectors may be under immediate charge of some assistant engineer to whom they make immediate reports	2,400	3,000
If inspectors are employed during working season only to receive per month	250	300
Inspectors working the year around are at division offices during winter on plans, estimates and computations, as assigned.		
JUNIOR ENGINEERING POSITIONS CONCERNED WITH ROUTINE WORK ONLY		
Engineering, Draftsmen, Computers, Checkers, Estimators— Assigned to state headquarters	1,800	2,400
Tracers, Computers, Checkers— Assigned to bridge engineer	1,800	2,400
Engineer Draftsmen— Assigned to division headquarters. Preparation of plans, computations, estimates, checking	1,800	2,400
Instrument Men— Transitmen and levelers. Those employed the year around work inside division offices part of time on plans, computations and estimates	1,800	2,400
If employed by month during construction season only, they should receive, per month	200	250
Rodmen and Chainmen	1,200	1,500
Laboratory Assistants— Routine testing, laboratory records	1,800	2,400

All engineers working away from state or division headquarters to which they may be assigned are to receive traveling and subsistence expenses.

This schedule not to operate to reduce any salaries now existing.

Any comments or suggestions on the foregoing schedule should be addressed to the American Association of Engineers, 63 E. Adams St., Chicago.

The readers of Municipal and County Engineering will be interested to know that the association has organized committees at work drafting similar schedules for county highway engineers and for engineers in municipal service.

ASPHALTIC FILLER FOR BRICK PAVEMENTS

By Allen D. Dimmick, Middle Western Division, Asphalt Sales Department, The Texas Company

A number of articles recently appearing in the engineering journals, dealing with the subject of brick paving, have stated it as the experience of the writers that

VIEW ILLUSTRATING SMOOTHNESS OF BRICK PAVEMENT WITH ASPHALTIC FILLER, MAIN STREET, GALESBURG, ILL.

Constructed by J. B. McAuley, Galesburg, Ill. Texaco No. 32 Asphaltic Filler Used.

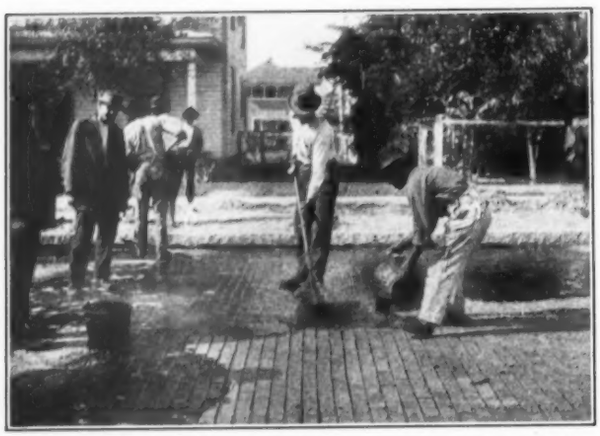
splendid results are obtained by the asphalt filler type of construction. It might be interesting in this connection to review a little of the history of this phase of brick pavement construction.

When brick pavements were first laid and it was necessary to find some material to fill the joints, merely to

keep the brick from rattling around on the base, sand was the first and most obvious material to suggest itself, and for a time was universally used both as a cushion under the brick and to fill the joints.

Why Sand Filler Failed

It was soon realized, however, that brick pavements laid in this manner were open to a number of objections. Far from being waterproof, the sand filler actually blotted up the water, which collected between the foundation and the wearing surface resulting in ultimate disintegration of the latter. The brick, as the sand ran or was blown out of the joints, showed a tendency to chip and spall at the unprotected edges under the impact of traffic and horses' hoofs. Worst of all, no way could be found to keep the sand in the joints, which were soon emptied and the brick left loose on the sand cushion beneath, which consequently became more and more uneven as the brick moved in their bed, resulting in inequalities in the surface. Furthermore, the joints became unsanitary as they were filled with street liquids and refuse. The extreme noisiness as compared with the various forms of bituminous construction furnished another objection on the part of property owners.



APPLICATION OF ASPHALTIC FILLER ON BRICK PAVEMENT BY THE SQUEEGEE METHOD, NEWPORT AVE., TAMPA, FLORIDA.

Constructed by Georgia Engineering Co., Augusta, Ga. Texaco No. 39 Paving Filler Used.

Introduction of Bituminous Filler

To meet these difficulties it was believed that a bituminous filler would give good results. It was immediately plain that a bituminous filler eliminated expansion troubles and the consequent heaving, as well as furnishing a perfect waterproof bond. The filler could also be poured flush with the surface of the brick and, to a great extent, protected the edges from spalling.

In the first decade of the twentieth century, when the pure asphalts began to come upon the market in quantity, they were promptly recognized as a superior filler, principally because the asphaltic filler retained its life as long as the pavement lasted, and was but slightly susceptible to temperature changes. In addition, asphalt was found to have great adhesiveness and binding power under climatic temperature changes.

Constant Improvement in Asphaltic Filler

As a result of these qualities asphalt was quickly adopted very generally as a filler, and each year showed less and less of the older expedients in use. Of course a wide difference has always existed and always will between the better and cheaper grades of asphaltic filler on the market. There has been a constant improvement in the quality of asphaltic filler produced, and this has been reflected in the increasing use of it throughout the country. Mr. Geo. W. Tillson, a recognized authority, writing five years ago, stated that sand filler had been almost entirely abandoned at that time.

Expansion and contraction are the natural enemies of a brick or block pavement. Expansion naturally occurs as a result of extreme heat, and contraction takes place during the cold weather. It is clear that a successful joint between the bricks or blocks should allow for this contraction and expansion and at the same time prevent the bricks or blocks from shifting in their positions on the base, and at the same time preventing excessive internal stresses in the pavement surface.

From these natural tendencies through which the success or failure of a brick pavement is largely affected, it must appear that a filler must be placed between the bricks which is of such consistency that it will adapt itself to climatic changes. At the same time, it must adhere firmly to the blocks at various temperatures, and above all not bleed or flow in hot weather, nor become brittle and pulverize in cold weather.

Rolling is Necessary

In order to obtain a true and even contour on the surface of the pavement, the blocks should be thoroughly rolled, but not too heavily, as an excessive weight will push the blocks into the sand cushion on which they are laid, as a result of which the sand pushes up through the interstices between the blocks thereby occupying the space which the filler should occupy.

Applying Asphaltic Filler

Two methods of applying asphaltic filler have been used more extensively than any others. One method is by pouring the asphaltic filler into the interstices between the bricks from pouring cans, the spouts of which are designed so as to be trough-shaped. The other is called the squeegee method in which the hot asphalt is spread directly over the surface of the blocks and forced into the joints by either rubber or hot iron squeegees. Two applications of the asphaltic cement are usually desirable to procure the best results, because after the filler has been poured it penetrates the cushion and shrinks in the process of cooling.

Maximum results are procured when the filler is heated to a temperature of from 350 to 400 degrees Fahrenheit.

Sand Should Be Hot

When the joints between the brick have been thoroughly filled with asphaltic filler, a uniform spreading of clean, sharp sand should be made over the surface of the pavement. The sand should be heated to a temperature of approximately the same as that at which the asphalt was poured. The hot sand sinks into the asphalt and settles into the joints, producing a material which is somewhat in the nature of a mastic.

Rolling is usually proper after the sand has been evenly spread and before the asphalt is thoroughly cool. Rolling imbeds the sand into the asphalt and causes an even contour of the surface of the blocks.

As a summary, it might be stated that an asphaltic

VIEWS OF APPARATUS USED AT BINGHAMTON, NEW YORK, IN TESTS TO DETERMINE DISCHARGE OF VARIOUS SPRINKLING FILTER NOZZLES UNDER VARIOUS HEADS.
Fig. 1 (Left). Stilling Box and Supply Lines. Fig. 2. Discharge End of Apparatus. Fig. 3. Close View of Supply Pipes.

filler produces a pavement which is not affected by temperature changes, and that cannot be permeated by water and street liquids. The asphaltic filler protects and prolongs the life of the blocks and reduces the noise common to brick pavements laid with rigid fillers. Furthermore, it provides a surface which is smooth and comfortable, less expensive in upkeep and highly attractive in appearance.

TESTING DISCHARGE OF SPRINKLING FILTER NOZZLES

By W. Earl Weller, City Engineer, Binghamton, N. Y.

The Bureau of Engineering of the city of Binghamton, N. Y., has recently completed a rather extensive series of tests to determine the discharge of various sprinkling filter nozzles under various heads. The results of these tests are shown in the accompanying diagram. (No. III.)

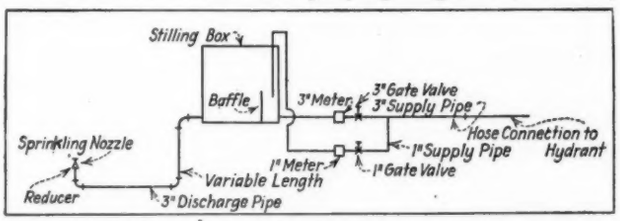


DIAGRAM 1. DIAGRAMATIC SKETCH SHOWING ARRANGEMENT OF APPARATUS FOR SPRINKLING FILTER NOZZLE TESTS.

The apparatus consisted of a metered connection to the city's water supply, a stilling box 3 ft. x 3 ft. x 3 ft. inside, and a discharge line. The apparatus was set up in such a manner as to make possible the variation of the static head from 1 ft. to 12 ft. by merely changing the vertical length of pipe in the discharge line. The arrangement of the apparatus is most clearly shown in the diagram and illustrations accompanying this description. It will be noted from diagram No. 1 that a 3 in. and a 1 in. supply line are provided. These were necessitated by the variation in flow, the 3 in. line being used for high heads and free discharges and the 1 in. line being used for low heads and small discharges.

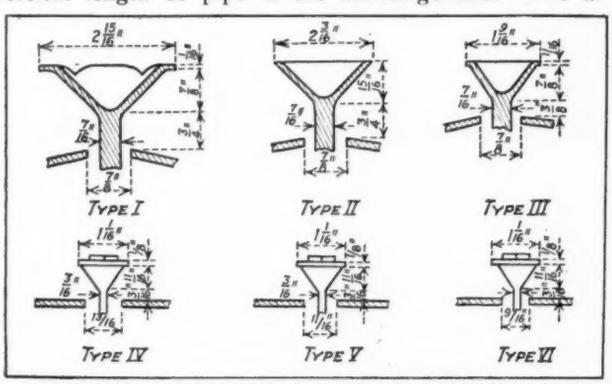


DIAGRAM 2. CHARACTERISTICS OF NOZZLES USED IN TESTS.

In conducting the tests the sprinkling filter nozzle was first omitted and a determination made of the discharge through the remainder of the system. Water was admitted to the stilling box through the 3 in. line until the surface stood at a predetermined level above the outlet. By adjusting the gate valve on the supply line the surface was maintained at this elevation while 80 to 100 cu. ft. of water passed through the apparatus. The time consumed was measured by stop watch. Prior to the starting of the test the area of the discharge end of the reducer had been carefully determined. These observations gave the factors "Q" (discharge in cubic feet per second) and "a" (area of discharge) from which "v" (velocity of discharge) could be computed. This velocity was changed into terms of head available at the nozzle by the usual formula. The computed head was checked by an actual observation. The purpose in observing the free flow through the apparatus was to obviate the necessity of computing the friction head in the system. After the available head had been determined for one eleva-

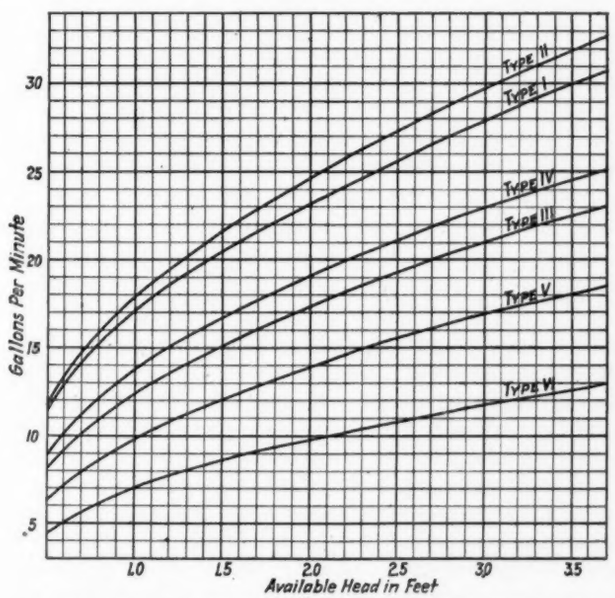


DIAGRAM 3. DISCHARGE CURVES FOR SIX TYPES OF SPRINKLING FILTER NOZZLES.

tion the water surface was raised or lowered 6 ins. and a new series of observations taken.

When the complete range of heads possible without a change in the discharge piping had been observed, as explained above, the various nozzles were similarly tested, "Q" being computed directly from the meter readings and the observed times. In the plot of results "Q" is given in gallons per minute and "h" in feet of head acutally available at the nozzle. The characteristics of the six types of nozzles tested are shown in diagram No. II. Types 1, 2 and 3 are Taylor nozzles, type 1 being a so-called "square" spray type. Types 4, 5 and 6 are Worcester nozzles differing from each other only in the size of the openings.

RECENT DEVELOPMENTS IN CONCRETE HIGHWAY CONSTRUCTION

By A. N. Johnson, Consulting Highway Engineer, Portland Cement Association, 111 West Washington Street, Chicago, Ill.

There are many features connected with the general design of concrete streets and roads which are of importance but of which the limited space allotted to this article will not permit more than a brief mention.

The subgrades should receive more attention. It is desirable to have the bottom of the concrete slab as nearly a true surface as the top. Where heavy clay soils are encountered it is better not to roll the subgrade to any extent but shave down the final inch or two by hand or with a subgrading machine. Evidence exists to prove that heavy rolling of many soils results in subsequent disturbance of the pavement; for these soils, as soon as any moisture reaches them, swell and actually heave the pavement.

Street corners should be rounded to a radius of not less than 20 ft.

The construction of concrete streets makes possible the use of integral curbs, which are not only more economical, but are readily constructed, present an excellent appearance and avoid any chance of displacement which so often occurs with separate curbs. The face of the curbs should not be perpendicular but should have a slight batter so that the upper corner will not come in contact with the rims of motor vehicles.

Grading of Aggregate

Much progress has been made in our knowledge of the use of variously sized aggregates and their proportioning for concrete mixtures. This has been made the subject of most exhaustive study and investigation by Professor D. A. Abrams of the Lewis Institute, Chicago. The results that he has obtained have shown that the arbitrary divisions of fine and coarse aggregate by sizes to be found in many specifications do not necessarily give a grading that will produce the best concrete or, in fact, be even a measure to indicate the relative value of various aggregates. If many of the gradings specified for fine aggregates were strictly enforced, it would result in the rejection of much material from which as good concrete could be made as with material that would be accepted under a particular specification.

Consistency

One point on the subject of mixing concrete should be mentioned, which is, the great importance that the amount of water exercises on the strength of the resulting concrete. The less water that is used, compatible with securing a mixture that is workable, the stronger the concrete will be. This fact, but recently understood, is a further result of the investigation of Professor Abrams.

In order to measure the consistency and make a definite specification therefor, there has been developed what is known as the slump test. This is most satisfactorily performed by the method devised by Mr. F. L. Roman, testing engineer of the Illinois State Highway Department. He uses for the purpose a light metal mold in the form of a truncated cone 12 ins. high, having an 8 in. base and a 4 in. top, into which the concrete is placed. The conical shell is removed by means of handles attached to the mold and resulting slump in the concrete is noted. This method, Mr. Roman has demonstrated, gives very consistent results and is a better measure of the consistency than if a cylinder is used to make the slump test. The amount of slump for concrete to be placed with a finishing machine should be about ½ in. to 1 in., a trifle greater allowance being made for concrete with rounded pebble aggregate than with crushed stone aggregate.

Improved Methods of Finishing

Aside from improved methods of handling materials the developments in concrete road construction have been chiefly improvements in methods of finishing. Of these, the first place must be assigned to the roller. The roller that is used in finishing a concrete pavement consists of a light metal cylinder 10 or 12 ins. in diameter, about 6 ft. long, weighing not to exceed 100 lbs. On roadways 18 ft. or over in width the roller is most conveniently and effectively operated by means of ropes attached to a double bail. Two men, one on either side of the pavement, pull the roller back and forth over the freshly laid concrete. This operation is repeated at intervals of 10 to 20 minutes, as often as there rises to the surface a film of water which the roller squeezes off to the edges. This water, if it remained in the concrete, would greatly lessen its strength and if not removed from the surface there would be a thin layer of laitance, which is very apt to scale and present an undesirable appearance.

After the pavement has been rolled not less than four and possibly five times it is finished with a broad canvas belt or thin board. The belt or board is drawn over the surface with a see-saw motion and leaves a uniform even finish to the concrete. Excellent results have been obtained by attaching a belt to a thin board which serves as a bow by which the belt is stretched.

Previous to using the roller a heavy tamping template should be employed or, in the case of street work which may be too wide to use such a template, the surface should be hand-tamped.

An interesting point in connection with the development of the use of the roller is the fact that while the roller and its effect upon newly laid concrete are described by Mr. E. L. Ransome in the 1910 edition of Gillette's Hand-Book of Cost Data, its general adoption as an adjunct to concrete road construction was not until 1917.

Mechanical Finishers

Mechanical finishers have now been developed that are used very successfully upon roadways up to 20 and 24 ft. in width; and are being constructed to operate upon even wider roadways. These machines shape the concrete, at the same time tamping it, and are also provided with an automatic belting arrangement. Concrete of a comparatively dry consistency is required if the best results are to be obtained. In the event somewhat too large a quantity of water is used the effect of the tamping is to bring considerable water to the surface. These machines should then be followed with a roller to be sure that the excess water on the surface is removed and not allowed to stand upon the fresh concrete. Such a machine to be successful must be easily reversible so as to be operated a number of times over the same area.

An important object to be gained by using the roller or finishing machine over a given portion of the concrete surface for a number of times extending over a period of 30 or 40 minutes is to keep the concrete plastic during a long enough period to overcome the formation of minute shrinkage cracks that may occur with the initial set and which may develop where the concrete is given but one application, either of the roller or the finishing machine. If it is noticed that shrinkage cracks still occur, then the operation of the machine or roller should be continued for a longer period.

Use of Machinery in Concrete Road and Street Construction

The time is approaching, in fact has approached, when to employ unnecessarily a number of men upon a given job is little short of an economic crime. More than ever attention must be given to the application of machinery and labor-saving devices in all forms of construction; and this applies with special force to paving work, where there is opportunity for much improvement.

The construction of concrete pavements lends itself very readily to labor-saving devices, many of which have now been perfected so that today it is practicable to lay concrete pavements with a minimum of hand work, that is, nearly every man upon the job will be operating machinery. On the average for concrete highway work there need be required but four or five men doing only hand work.

A central material plant where materials are unloaded by power, transported thence to the work on a narrow-gage industrial track, thence to be lifted by derrick to the mixer, constitutes an economical set up. This method of hauling the materials enables the work to proceed through bad weather when team hauling would be impracticable; the number of men necessary is greatly reduced from the old method of placing materials upon the subgrade and shoveling them into the mixer; the materials themselves are kept cleaner, are not wasted to the same extent, and the subgrade remains in better shape. In general, to place materials directly on the subgrade is a clumsy, costly and defective way of doing the work.

A recent development is to handle the concrete from a central mixing plant, and under many conditions this promises to be one of the most economical and expeditious methods of laying concrete pavements. It should have particular application to the laying of concrete streets when the concrete may be mixed at the railroad yards or near by where materials are received, and hauled to the work in trucks. In this way the particular street to be paved need not be encumbered by any materials, may remain open to traffic up to the last minute, and kept closed for a minimum period.

To insure rapid prosecution of work the contractor should be required to assemble a sufficient amount of materials to insure that no delays arise on this account.

Recent experience in handling cement in bulk demonstrates that this is not only thoroughly practical but is economical. A good method is to deliver the cement in open-top cars protected by tarpaulins. To use cement delivered in this manner economically it is necessary that the job be of such size as to warrant building cement-storage bins capable of molding from 25 to 50 cars of cement. The cement is readily unloaded by means of a clam-shell bucket.

The storage bins required for the sand and gravel need be no larger than is necessary to hold a sufficient amount to fill one or two trains of the small cars. The principal storage should be in storage piles. An excellent arrangement for these is to depress the track so that there will be a tunnel made beneath the storage pile and no storage bins are then necessary.

Alley Construction

An economical method for handling alley work is to have the materials delivered at the head of the alley on an adjoining street, where this is practicable. The mixer is stationed nearby and the mixed concrete delivered by small gasoline-driven buggies.

It is a good practice in laying an alley that abuts upon buildings or high fences first to lay a form about 18 ins. from either edge of the alley and fill the concrete behind this form adjacent to the buildings or fences. This strip on either side finished, the forms are removed, and the center of the alley is placed, the side strips offering a place for the workmen to finish with facility the center portion of the alley.

Where it may be necessary occasionally to gain access to pipes or conduits the procedure would then be to lay a narrow strip of concrete directly over the line of the conduit separate from the remainder of the pavement. It is assumed that this strip will be at the center of the alley. First one side will be laid, then the other and last the 18 in. or 2 ft. space at the center. There should be no joint material put in but the edge of the concrete before placing the center portion may be painted or oiled, in this way assuring ready removal of the center section whenever it may be necessary. When finished the joints should be practically unnoticeable.

The Use of Reinforcement

The function of reinforcement in concrete roads seems to be a matter of some confusion. The amount of reinforcement which is generally used and beyond which amount it is not practicable to go, does not to any great extent reinforce the concrete slab in the sense that a concrete beam or girder is reinforced by steel rods. That is, no great increase of structural strength is produced. The chief effect secured is not so much the prevention of cracks as to prevent cracks that do form from opening and becoming of any appreciable width; so that the chief function of reinforcement in concrete roads is to hold the concrete slab together after it may have cracked.

Some have contended that if reinforcement were used a thinner slab might be employed than if no reinforcement were put in the pavement. If the amount of reinforcement were 10 to 20 times as much as is used there would be some ground for such contention, but where the amount of steel does not exceed 40 to 50 lbs. per sq. ft., and usually it is considerably less, the increased strength given the slab is so slight that it is practically negligible in so far as being able to reduce by any appreciable amount the thickness of the slab. The best reinforcement to increase the strength of the slab is added thickness. This not only gives a much stronger slab but also one of greater weight and therefore of greater inertia, which is of importance when the nature of the loads and shocks produced thereby are considered.

General practice today regarding reinforcement is to use it on those portions of the road where the greatest disturbance is expected in the subgrade as, for example, on clay hills. It is also the general practice to reinforce streets where it is desirable to hold to a minimum in size such cracks as may form. There is also an increasing tendency to use large metal units of reinforcement, that is, larger bars spaced further apart, rather than smaller ones spaced closer.

Reducing Prices for Pavements

In closing may I disgress to say a word as to paving prices? If there are certain causes which make for higher prices and it is possible to remove the causes, then to that extent will lower prices be secured. Let us discuss for a moment some of these causes.

Whenever a contractor is in doubt, when he is confronted with uncertanties, when he must assume certain hazards, he endeavors to secure himself against possible loss and makes his bid price accordingly. At the present in most paving contracts the contractor must assume all the hazards and in proportion to the degree of risk to be incurred does the bid price increase.

The hazards to be encountered may roughly be divided into two classifications. First, those which, although perhaps inevitable, it is nearly impossible, even after the work is completed, to assign just to what extent the cost of the contractor has been affected. Under this heading would fall the hazards due to weather conditions.

Of the second class are those hazards which, when they occur, their financial effect upon the contractor can be definitely calculated. In this class would come a change in freight rates during the term of the contract. Under such conditions the contractor can readily show definitely how much more or less the work cost, due to the difference in freight rates on the materials involved. These two examples are perhaps sufficient to indicate the difference in the nature of the hazards which every contractor making a bid must consider.

The added price he must charge is in the nature of insurance. If the risk were removed then there would be no need for an insurance charge, and the bid price should be that much less. It is submitted that, certainly as to those risks which come under the second classification, the public can insure itself to much better advantage and assume itself some of the risks for which contractors now make a very considerable charge.

Contracts should be so drawn as to relieve the contractor of every uncertainty and hazard that it is possible to foresee. Surely every contract should provide for an adjustment to be made in case freight rates are changed subsequent to the execution of a contract, if increased then additional compensation for the contractor; if reduced like advantage to the public.. If, in order to hasten completion of work and avoid delays costly to both contractor and the public, it is desirable to store quantities of materials ahead, allow the contractor a fair advance upon such materials. If a contractor is required to store materials but paid only for completed work he must charge for this service and the risk incurred. And this charge will be more than the cost to the public to advance to the contractor the money necessary to pay for the materials stored.

But it is not so important here to give specific examples as to call attention to the general principle that lower bid prices will be secured upon street and highway work to the extent that the contractor is relieved of risks. The engineers in the public employ could well consider carefully every chance and hazard that may arise during the prosecution of a given paving project and so draw the specifications and contract as to relieve the contractor of every uncertainty possible. The method that imposes upon the contractor all the risks and requires him to do all the guessing is both costly and unbusinesslike.

Acknowledgment

The foregoing is the major portion of a paper presented by Mr. Johnson before the American Society for Municipal Improvements at the New Orleans convention, November, 1919.

ACTIVITIES OF AMERICAN ASSOCIATION OF ENGINEERS

To the Editor:

Unity in the engineering profession is a necessity. It will be achieved only by building up one strong, universal society; a democratic unified organization. To date, we have more than eight thousand members in good standing and they represent our activities in every part of the United States. The A. A. E. plan gives 3 or more members in your community a club charter and 20 or more a chapter charter. Under each chapter as many sections may be organized as are needed to represent the membership. At present, A. A. E. has 50 chapters and 33 clubs in operation.

Ethics for the engineering profession have been promoted by this association and in an earnest attempt to better them we have submitted the "Engineer's Creed," which includes a code of ethics accepted by many as the greatest contribution to the subject. In the very near future the association will print the "Engineer's Creed" in a high class booklet, complimentary copies of which will be distributed to all members.

Professional Engineer is the new name selected for our official publication. This will be an improved magazine of large size devoted to the engineering profession. It will be non-technical; a business service magazine for engineers. The magazine will be an important step towards "Promulgating the association ideas through publicity."

Compensation problems have taken much of the asso-

cition's time and money since its origin in 1915. During this time many individual benefits have been secured and many engineers have received relief that was greatly needed. General increases have been received in four regions of the U. S. Railroad Administration and have been promised in two of the three remaining. The increased salary schedule for technical men in the Navy was authorized; a new schedule for highway engineers has been proposed. A special committee on Schedule of Salaries for Engineers in Public Service is working on other new schedules. Several local committees are developing a new schedule for telephone engineers. In all these matters A. A. E. has taken the leading part and our activities have not been opposed, because we are recommending fair compensation.

Civic Activity—Nearly all of our chapters are taking their part in their communities in a civic and political way. Let us cite two recent national activities to show what 8,000 engineers can do. On receipt of news from Washington that an attorney was about to be appointed to the vacancy in the Interstate Commerce Commission, a flood of wires and letters from the chapters and individual members protesting the appointment of a lawyer and urging the appointment of an engineer resulted in deferring the appointment for the present. A. A. E. is credited by the chairman of the National Service Committee of Engineering Council with doing more than any other society to further the Jones-Reavus Bill providing for a Department of Public Works in the U. S. Government.

Employment for technical men is a great activity in the Service Department and Employment Committees of our association. The volume of this work is indicated by the average business for three months period ending September 30.

Positions received	1,084
Applicants introduced	2,985
Members placed	264

Thirty-three and thirty-five members were placed in positions for the weeks ending October 11 and 18, respectively.

Fourteen members were placed in new positions on October 20. With a greater organization our Service Department will be able to sell more engineering service at a greater price.

Opportunities for new members in A. A. E. today are greater than ever and the new member will share these with the other members of the profession after he joins. We write this letter to point out the advantages of joining immediately. There is still limited time to complete a membership this year and to be enrolled at the present entrance fee of six dollars. This will be a saving of four dollars because the entrance fee next year will be ten dollars. A. A. E. offers nation-wide opportunities to the engineering profession. The entrance fee should accompany the application.

Yours for co-operation,
A. H. Krom, Assistant Secretary,
American Association of Engineers.
63 E. Adams St., Chicago, Ill., October 30, 1919.

LARGEST SWIMMING AND SKATING POOL IN THE UNITED STATES

The Clifton Park swimming pool at the southern end of Clifton Park, in the city of Baltimore, Md., is the largest artificial swimming pool in the United States, if not in the world. This article, giving a description of the pool with data on its cost, is from the official journal of the municipality of Baltimore.

General Design Features

The pool is elliptical in shape, with a maximum diameter of 595 ft. and a minimum diameter of 340 ft.

The deep water section of the pool is also elliptical in shape, with a minimum diameter of 170 ft. and a maximum diameter of 356 ft. This deep water ellipse is at one side of the pool area, and from the line of this ellipse the depth increases at a 10 per cent. grade. From the shallow edge of the pool to the deep water ellipse, the grade ½ of the way is 1 per cent. and for the balance of the way 1½ per cent.

The maximum depth is 9 ft. and the minimum 3 ins. The pool has a capacity of 4,500,000 gals., with a water area, when filled, of 3.7 acres.

Site of Pool

The area selected for the pool construction was triangular in shape, bounded on two sides by city streets intersecting at right angles, with a high railroad embankment along the other side, containing about 9 acres. The construction of the high-ways was upon filled ground similar to the railway embankment, but of much less elevation, so that the area without drainage would have formed a natural pond or pool.

Preparation for Pool Construction

A 48-in. combination storm water sewer line from a residential section north of Clifton Park had been carried to and under the railroad embankment into the triangular area where the line was partly exposed. There was also a considerable wash from the railroad embankment, and by way of preparation for the pool construction considerable grading and filling was necessary. The cost of this work was as follows:—

4,230 labor hours @ 25c	$1,057.50
356 team hire hours @ 62½c	222.50
330 ft. 6-in. terra cotta pipe with fittings	69.60
11,727 cu. yds. of earth @ 10c	1,172.70
Total	$2,522.30

Specifications and Contract

Plans and specifications were prepared by the Park Engineer and contract awarded by the Municipal Board of Awards at an expense of—

$40.00	for design
62.45	for printing
25.65	for advertising
Total	$128.10

The contract work was commenced about the middle of April, 1915, and completed in 94 working days. The time allowance in the contract was 120 working days, with a bonus of $10 per day for completion in less time, so that the bonus earned was $260.

Cost of Work Done by Contract

The items of work, done under contract, cost as follows:

Excavation—4,651 cu. yds. @ 35c	$1,627.85
Filling and replacing—5,888 cu. yds. @ 25c	1,472.00
Trench excavation and backfill—1,041 lin. ft. @ 45c	456.30
Ten-inch vitrified pipe—1,041 lin. ft. @ 33c	334.62
Lumber placed under drains, 410 B. M. ft. @ 3c	12.30
Concrete drain inlets—7 @ $35 each	245.00
Under-drains in place—483 lin. ft. @ 75c	362.25
Concrete pit and drainage outlet	20.00
Changes to sewer line (including man-hole)	210.00
Man-hole for drainage valve	90.00
Excavation and back-fill, water supply—510 lin. ft. @ 56c	285.60
Eight-inch cast iron water pipe with connections—510 lin. ft. @ $1.50	765.00
Eight-inch supply valve	25.00
Excavation and back-fill for pool drain—100 lin ft. @ 75c	75.00
Fourteen-inch iron drain pipe with connections—100 lin. ft. @ $2.40	240.00
Fourteen-inch drainage valve in place	55.00
Lighting conduit (1½-in.) in place 2,402 lin. ft. @ 24c	576.48
Lighting conduit (2-in.) in place 300 lin. ft. @ 27c	81.00
Light post foundations—7 @ $24 each	158.00
Light post foundations—11 @ $8.50 each	93.50
Concrete life buoy bases—23 @ $5.40 each	124.20
Excavation and back-fill for concrete wall along side of pool at deepest point—539 cu. yds. @ 50c	269.50
Concrete in wall, furnished and placed—332 cu. yds. @ $8	2,656.00
Steel reinforcement rods for wall and pool bottom—68,249 lbs. @ .026 per lb. in place	1,774.37
Wire mesh reinforcement—15,670 sq. yds. @ 8c	1,253.60
Concrete for pool bottom in place—1,838 cu. yds. @ $5.86	10,770.68
Concrete walk around pool—15,473 sq. ft. @ .096c	1,485.41
Overflow drains and boxes—6 boxes, 200 lin. ft. of pipe	310.00
Spring boards in place—2 @ $10	20.00
Concrete structure for sliding boards, with two concrete slides	1,425.00
Miscellaneous extra work	280.54
	$27,564.20

Cost of Work by City Forces

Electric lighting was installed by park electricians on force account, at a cost for material and labor, as follows:

18 cast iron posts in place, $27 each	$486.00
3,942 lin. ft. of cable in place @ 10c per ft.	394.20
18 lamps @ $4.14 each	74.52
18 globes in place @ $4 each	72.00
18 transformers @ $.2777 each	95.00
18 switches @ $4.50 each	81.00
	$1,202.72

The cost of water supply, connection made by the Municipal Water Department, was as follows:

Labor	$109.73
Material	159.20
Total	$268.93

Total Cost of Construction

The total cost of the pool, including lighting equipment, but not including showers, diving rafts, dressing rooms or other equipment was $31,946.25.

Operation of the Pool

The water supply is through the city reservoir and filtration plant from the Gunpowder River. The water is supplied through one 8-in. inlet pipe and through one needle shower with 1½-in. supply pipe. There is one outlet or drain pipe 14 ins. in diameter. By regulation of inlet and drain valves there is a constant circulation of water, and the pool is emptied and cleaned annually. The city filtration is depended on for the purity of the water and chemicals are not used. Bacteriological tests of the water have never been made.

All bathers are required to pass under shower before entering the pool, and the use of soap is strictly forbidden. The average daily attendance during 100 days of operation in 1918 was 900 persons, and the average during the first 50 days of operation in 1919, 1,400 persons. The maximum daily use of the pool in 1918 was 4,254 persons on August 6th, and in 1919 4,674 persons on July 5th. The pool is opened during the first week in June, and is continuously operated for a period of approximately 100 days.

During the winter months the pool is available for skating when ice freezes a sufficient thickness, which is very seldom.

There is a concrete pool building constructed at a cost of $45,000, in which there are four showers and 949 steel lockers of the best grade, with toilet facilities, and with ample accommodations for handling bathing-suits, etc. The building contains a steam laundering and drying plant, with the most up-to-date equipment. There are two frame wing additions to the concrete building, in which there are dressing compartments and racks, in which boxes are used for checking clothing as a substitute for steel lockers. These two wings cost $10,000, and will accommodate at one time 2,400 persons or a maximum of 24,000 persons on any one day. The operating organization is under the Superintendent of Clifton Park, and the employees are classified and paid as follows:

1 Manager	$20 per week.
1 Engineer (laundry machinery)	20 per week.
1 Head life guard	18 per week.
8 Life guards	16 per week.
8 Lockermen	16 per week.
1 Head woman attendant	14 per week.
1 Ticket cashier	12 per week.
7 Women helpers	10 per week.

Cost of Operating the Pool

The annual cost of operating the pool is something in excess of $12,000. The exact cost is not known, owing to the fact that the pool has not been in operation under park management long enough to show the depreciation cost of towels and bathing-suits. The receipts from the Clifton pool in 1918 (the first year of park operation)

were $4,576.96, and the total patrons, not counting free entries from Charitable Institutions, 83,865 persons.

Income From Baltimore Swimming Pools

The Park Department has two other outdoor pools, and the number of bathers and the amounts collected at each for the season of 1919 were as follows:

1919.	Total Patrons.	Total Collected.
Patterson	115,428	$4,972.33
Clifton	118,694	7,189.13
Gwynn's Falls	34,616	1,582.23
Total for 99 days of operation	268,738	$13,743.69

The corresponding figures for the outdoor pool operations in 1917 and 1918 are as follows:

	Total Patrons.		Total Collected.	
	1917.	1918.	1917.	1918.
Patterson	138,341	113,711	$3,525.42	$3,574.37
Clifton	92,565	83,865	2,733.74	4,576.96
Gwynn's Falls	76,554	45,374	1,494.34	1,570.08
Total for 100 days of operation	307,460	242,950	$7,753.50	$9,721.41

CHARACTERISTICS OF PAVEMENT TYPES AND CONSIDERATIONS AFFECTING A CHOICE IN KANSAS CITIES

By A. P. Learned, of Black & Veatch, Consulting Engineers, Interstate Building, Kansas City, Mo.

The subject of paving is indeed a broad one and to discuss it with its various ramifications is impossible at this time, but it is my intention to mention briefly a number of the items which are of general interest to all of us. We pave our streets to better transportation facilities, to better sanitary conditions and to improve the appearance of our city; namely, we pave for commercial, sanitary and aesthetic reasons.

Factors Influencing Choice of Pavement

The choice of pavement should be based on its cost, which includes first cost and maintenance, its value for transportation as influenced by tractive resistance, slipperiness or climatic conditions that may affect its usefulness, its sanitary qualifications and its general appearance. Affecting the item of maintenance is durability which is a very vital factor in one's selection because of the objection to continued maintenance, or the objection to a road being in such a condition that it needs to be repaired.

Width of Pavement

Before the selection of the pavement, or at least before it is built, it is quite necessary to determine the width of pavment to build and then is town pride put to test and it becomes necessary to advise the well meaning citizen, who would pave the business district 80-ft. wide if there is room, and the resident district 40 to 50-ft. wide, that the traffic, which passes down New York's famous Fifth Avenue, passes down a street 75-ft. between curbs and then he should realize that when the width is not too narrow that yardage in length rather than in width will be of the most benefit to the City as a whole and will not result in excessive cost to the property owner.

There are a great number of items that enter into the selection of the width for instance, whether it is the intention to park on the side or the middle of the street, whether the street is one of heavy or light traffic and whether it will fit up with the general scheme of the street. There is quite a general practice in this section of the United States to build the pavement just as wide as it will permit, allowing 12 to 16-ft. for sidewalks in the business district and to build in the strictly residence districts pavements 25 to 30-ft. wide. A width less than 25-ft. proves too narrow and one wider than 30-ft. unnecessarily wide.

In this connection we have found that with motor traffic it has been found necessary to figure travel widths of a vehicle from 8 to 11-ft. instead of 6 to 8-ft. as heretofore, and that the width of the street should be figured in multiples of this width; for instance if we figure the street for three vehicles at 9-ft. clearance, the width will be 27-ft. The returns at street intersection need to be large to furnish the space for turning around in the narrow streets, and to facilitate the turning of corners by the rapidly moving vehicle without its running out into the street.

Four Types Considered in Kansas

The next problem that confronts is to determine what kind of paving we should select for our city. There are, if we have determined upon what is regarded as a truly hard surfaced pavement and one that does not necessitate a regular annual maintenance, four kinds to be considered; namely: concrete, asphaltic concrete, sheet asphalt and brick. I have not included wood block and pavements of that class because our conditions, both traffic and financial, do not warrant its consideration.

Two Types of Concrete Pavement

When we consider and discuss concrete pavement there are two types of concrete pavement; namely: The one course, and the two course pavement. In this section of the country there is not a large amount of concrete pavement and there is a reticence shown towards building it. However, we find in the states of Michigan and Wisconsin a considerable amount of this character of pavement and it seems logical, for in that section of the country the aggregate available is satisfactory for wearing surface. To be perfectly frank, one of the serious drawbacks of concrete pavement in this section of the United States is the securing of the proper aggregate for the wearing surface.

In the single course concrete the aggregate of necessity is the same throughout while in the two-course concrete the aggregate in the wearing course may be entirely different from that in the base course and it is the better practice to use as near as possible the local material for the first course and to ship in a proper aggregate for the wearing course; that is, such as crushed Joplin flint or material equally as good, such as Wisconsin granite. The shipment of this material for the total thickness of the pavement would make it excessively expensive. There is no reason why the two-course pavement will not afford, if properly built with reinforcement between the courses and adequate expansion, a first-class pavement.

One of the arguments against concrete pavement in the past has been its noisiness, its slipperiness and its hardness, but with the increased use of motor driven vehicles

with pneumatic tires, these objections, especially of hardness and noisiness, are set aside.

Development of Concrete Pavements

Concrete pavements, or at least the present type of cement concrete pavements, are of recent construction. We find that in 1879 there was constructed in Scotland a concrete pavement that proved to be very satisfactory for a short time but when it started to wear, it wore out very rapidly. The conditions under which these pavements were constructed we are not acquainted with and there may have been some local reasons for its rapid deterioration.

The first concrete pavements in this country were built in 1894 but did not attain any particular popularity or general consideration until 1909 when the construction of a considerable amount of this pavement was undertaken by Wayne County Michigan, where their uniformly satisfactory results lead to a considerable discussion and, if we might say, popularized this pavement so that up to the first of 1917 there were 150 times as much concrete pavement as there had been previous to 1909.

Asphalt Pavements

Asphaltic concrete and sheet asphalt furnish the smoothest surface and probably embody, when first constructed, more of the requirements of an ideal pavement in so far as resistance to traffic and sanitation are concerned than any other kind. Sheet asphalt which is a pavement built up of a base, a binder course and a wearing course, was first built in a somewhat modified form in 1877, in Washington, D. C., on Pennsylvania Avenue. This is at least the first well known installation. This type of pavement had for a number of years a very extensive and high popularity but a little later, when cities of smaller size saw fit to pave, there was developed a pavement that could be built for considerable less money than the sheet asphalt and which provided in many respects the characteristics of sheet asphalt; namely, asphaltic concrete.

Asphaltic concrete is a bituminous concrete pavement having a predetermined mechanical graded aggregate composed of broken stone, gravel, sand, finely ground inert materials and is the outgrowth of a pavement known as the Excelsior pavement which was advertised as early as 1871 but of its installation we have no record. Asphaltic concrete as we know it in this section of the United States has been built largely under or with modifications of the Topeka Specifications. This pavement as ordinarily built consists of a 2-in. course of this bituminous concrete aggregate on a concrete base. The sheet asphalt ordinarily consists of a 1½-in. binder course and a 1½-in. wearing course rolled to 2½-in. in thickness. Certain requirements are very essential to the securing of a satisfactory piece of work in case of both sheet asphalt and asphaltic concrete. The proper rolling of the surface to thoroughly compact it and to get it smooth so water will not stay on the surface, resulting in the rotting of the asphalt due to chemical changes, is essential in both cases. It is necessary that an excess of asphalt be guarded against for an excess tends to soften it so that the street becomes wavy or it works down into the gutter. If too small a quantity is used the pavement will look dry and lack the proper elasticity. Within the last few years a condition that has as yet not been satisfactorily solved and is a problem of concern, has come up; namely; what will be the influence of the oils that drip from automobiles and that are sprayed out of the exhaust of automobile engines, and will it not be necessary, if this has an effect, which it seems it has, to determine the effect on different streets due to the likelihood of difference in intensity of traffic on this type of pavement?

Brick Pavements

Brick pavement as now built in Kansas is generally a fibre brick, so called, laid on a sand cushion upon a concrete base with an asphalt filler. There are also a number of stretches of so-called monolithic brick in which the filler is of cement grout and the brick has been laid directly upon the base when it is still green so that the contemplated effect is to make the pavement monolithic. Fibre brick have been used five years in this territory. However, the experience in brick materials is much older and the durability can be determined by the rattler tests. There has been an argument against brick pavements that they were hard and noisy. However, the use of an asphalt filler and the change from horses to motor drawn traffic has removed the cause for a large part of these arguments.

Life of Pavements

As was stated in our general consideration of this problem, we contemplate the consideration of these four types and it is only fair to say that the life of these pavements is somewhat a matter of conjecture. As one studies the general experience over the country he will notice that in certain cities one type of pavement gives absolute satisfaction while in other cities, pavement of the same type is entirely unsatisfactory. And again we find that the conditions which recommend a pavement to one individual condemn it to another. For instance, a number of people feel that asphalt pavements should not be used where the traffic is quite heavy because it softens in warm weather and will be cut up while others realize that the life of the pavement of that character is materially influenced and lengthened by the kneading and working that traffic gives it.

During the last five years there has developed in connection with the various types of pavements discussed quite extensive promotional organizations and these promotional organizations have, as a general thing, been striving to secure in their respective lines the highest grade of work possible in addition to the largest yardage possible and this feature of securing a high grade product has resulted in a different character of pavement being built throughout the territory than has heretofore been constructed. This fact means that we really, in this section of the United States, have no actual but only a comparative basis to compare our different kinds of pavement.

Influence of Construction on Pavement Life

There is of necessity a very much different life to a pavement built of high grade material than there can be to one of slip-shod construction. For instance take the brick industry. Several years ago it was quite the custom to have brick plants in a number of cities furnishing brick for these respective cities and the local plant so arranged the situation that only their brick was considered in the cities where they were located and a large number of these plants were producing a brick that was not of the character that should be used for this purpose. This has resulted in considerable criticism of this type of pavement that is truly unfair as compared to the present products. Such might be said of the other types of pavement up to

the time of their general standardization, although we must confess that there were previous to the present time at different places very high types of pavement built.

Costs

The general cost and particularly first cost of pavement have, by our accepted method of choice, a very vital bearing upon the selection of pavement and it is quite important that we consider it in the true light. In an analysis of the cost of the construction of brick paving previous to the present increase of prices, after the material was on the ground the labor cost for the paving was approximately 20 per cent. of the total amount but I find that although labor is being paid approximately 100 per cent. more than it was previous to the war time conditions, the labor item has increased 250 per cent. This is due to the decreased efficiency of common labor occasioned by the tremendous demand, and a general attitude of getting the pay and not necessarily delivering the required work. This results in a case of brick pavements that the labor item becomes 25 per cent. of the present cost. This as compared with the brick itself which has increased approximately 65 per cent. and cement which is close to 100 per cent., necessarily makes the present price of our pavement almost double what we paid previous to the war. The larger increase in the case of concrete and asphaltic concrete is largely because the proportionate part which labor plays in the cost of the work is somewhat higher and these products cost more nearly twice what they formerly did. For instance, in the case of asphaltic concrete the labor item, which formerly amounted to 22 per cent. of the total now amounts close to 33 per cent. The present price over the State in case of brick pavements ranges from $3.40 to $4.00 depending on local conditions. The cost of asphaltic concrete pavement is approximately 90 cts. per yard less and the cost of two-course concrete pavement is approximately 40 cts. less than the brick pavement under similar circumstances. The price of brick pavement previous to the increase was close to $2 a yard and you will note that compared with the average increase of prices from 1914 to December 1918 on all commodities was 194 per cent., the price of paving is not out of line. In other words, products received for your dollar in paving is as much proportionately and slightly more, than it is in the general average of all commodities.

In a comparison of these various types of pavement one should consider that in the case of sheet asphalt the material on top of the base is 2½-ins., material in brick pavement is 3-ins., and that in concrete and asphaltic concrete 2-ins.; therefore, the difference in price has logic.

To purchase a pavement at this time is not to purchase a luxury at a luxurious price, but is to purchase a utility at a price not out of line with the present purchasing power of the dollar in other industries. The popularity of street improvements is more noticeable at the present time than it has been for a number of years. For instance in the case of brick pavement there is over 50 per cent. more yardage this year than any year previous amounting to close to 1,500,000 sq. yds. The demand for improved streets and roads is the result of the change of our general transportation system from animal drawn to motor driven power; to the increasing population of our country; and the recognition that the motor is providing a means of transportation on short distances that is reasonably economical, and facilitates the movement of supplies and unifies the country. It is also the result of an unusual prosperity in this section of the country and the recognition of the fact that a small city can have, so far as utilities are concerned, as good as a larger city.

Maintenance costs will not be discussed for we do not have in the territory any valuable data on the subject.

Recognizing the fact that cities are having these improvements and that the prices are not prohibitive, and that the community can afford them, we are confronted with the question: How shall we proceed legally to procure such improvements?

Legal Steps in Kansas

In discussing this problem I have confined myself largely to cities of the 2d and 3d class and we find that the law permits the construction of improvements of this character by petition by 50 percent of the resident property owners on the street, or by resolution of the council, if they deem it necessary for the general well being of the community, provided said resolution is not protested against by as many as 50 percent of the resident property owners on the streets affected.

After this petition has been accepted, or the resolution has been properly advertised and not successfully remonstrated against, the city can let contracts for the work. To pay for paving, the law provides that general improvement bonds may be issued chargeable against the city as a whole to pay for all intersections of streets and alleys and for the bringing of streets to grade and that special improvement bonds may be issued to pay for that which is taxed directly to the property owners affected. The law also provides that these bonds may be issued for either 10 or 20 years, provision being that the 20-year bond shall not exceed 5½ percent and the 10 year bonds 6 percent and that these bonds may be paid off in equal annual installments. It is of course good practice, if the pavement is of such a character that it will not last to exceed 10 years, that these bonds be made of such a term that they will have been paid off before the pavement begins to deteriorate seriously. The law provides that a city may be indebted up to 15 percent of its valuation and this necessarily gives to our State means of providing for itself if properly handled a very considerable amount of street improvements, provided the sewer and water works which they may have, have not been excessively costly in construction due to peculiar difficulties.

It has not been my intention to recommend any particular kind of material to use for I feel that this is primarily a problem which is local in all of its aspects on account of materials available, financial resources, and requirements of the pavement, but it is my advice that whatsoever type is selected that an effort be made to secure the best of construction in that particular type for the best is none too good and in the end is the cheaper.

SUCCESS OF ASPHALT JOINT-FILLER IN VERTICAL-FIBER BRICK PAVEMENTS

By Clark R. Mandigo, Consulting Engineer, Western Paving Brick Manufacutrers' Association, Kansas City, Mo.

(Editor's Note—The following discussion on the success of asphalt filler in brick pavements by Mr. Mandigo is from his paper on vertical-fiber vitrified brick paving,

presented before the convention of the American Society for Municipal Improvements at the New Orleans convention this month. The entire paper is most interesting. The portion not here given was omitted for the reason that it pertains largely to the matters of manufacturing covered by Mr. Mandigo in his contribution to Municipal and County Engineering for July, 1919.)

The asphalt joint-filler almost universally used at present in vertical-fiber brick pavements has been so interwoven with the success of such brick pavements that mention must be made of the filler in discussing this type of pavement.

Four items affecting the pavement have contributed to the success of asphalt filler in brick pavements: (1) the method of application, (2) the shape and texture of the brick, (3) the quality of the filler, and (4) the changed character of traffic.

Taking these items up in order, first, the bituminous filler is heated to a temperature below its flash point, is flushed over the surface of the brick pavement and squeegeed back and forth until the joints are full, leaving, necessarily, a slight surplus on the surface. It is impossible to get the joints properly filled by the old method of pouring cans. No matter how carefully the work was done there was settlement of joints in hot weather. By flushing the hot asphalt over the brick a saving in labor is effected which more than offsets the slight additional amount of filler used. A coating of sand on the surface of the filled brick absorbs the surplus and, working into the asphalt, makes a good mastic.

In the second place, the wire-cut surface of the vertical-fiber brick which is uppermost in the pavement aids in retaining the thin asphalt mastic on the surface so that it doesn't scale off causing a dirty street. Without lugs the brick set up close and the square edges give a minimum width, even joint at the surface. The asphalt retained on the surface is only an incident to the proper filling of the joints and is not designed to be maintained. It remains, however, from three to five years and during that times acts as a reservoir for filling joints that settle, so that by the time it has worn off, all joints are packed tight with a solid asphaltic mastic. Dark spots on the joints of such a pavement are caused by the asphalt coming to the surface in hot weather so that the mastic filler is enlivened and renewed from the bottom of the joint.

In the third place, only the best quality of asphaltic cement is recommended as a filler, as this has proven to be the least susceptible to changes in temperature, possesses a long life, great adhesiveness, elasticity and malleability, and resists wear and rubber-tire suction. A grade of asphalt cement of about the consistency and requirements that would be specified in the best sheet asphalt pavements for an asphaltic base manufactured asphaltic cement has proven very satisfactory. Refined tar has been used in some instances, but does not at present seem to fill all the requirements.

In the fourth place, the preponderance of rubber-tired traffic on the modern pavement has practically eliminated maintenance of joints where soft filler has been used. When asphalt filler began to be used some eight or ten years ago, it was expected that the joints would require refilling on dense traffic streets every five to seven years, but the changed traffic conditions, which have practically eliminated the horse-drawn, steel-tired vehicle and substituted the rubber-tired automobile and truck, have not made this necessary. In fact, the droppings of oil and kneading action of the tires seem to keep the filler alive and prevent any signs of disintegration, or working out of the top of the joints.

The advantages of this type of street or road surfacing may be briefly summarized as follows: (1) The street or road may be opened for traffic as soon as the filler has been applied. (2) Service cuts and openings are easily and simply repaired. (3) It carries the minimum risk in construction, since serious defects do not result through careless workmanship, lax inspection, or ignorance—a real advantage in these days of inefficient labor. (4) The steps in construction are simple, all materials being tested before being incorporated in the pavement and an opportunity given to correct any mistakes by the following step. (5)The filler is easily manipulated, and not subject to damage by frost, rain or premature traffic. (6) Noise is eliminated. (7) It provides an ideal, non-skid, smooth riding surface for automobiles and gives a good grip for auto tires and horses on all grades. (8) Expansion and contraction are properly and effectively cared for. (9) The elastic filler cushions the brick and the foundation from shock and impact, reducing the thickness of base required and allowing slight readjustments between individual brick under traffic so that each brick remains solidly bedded in the sand cushion—there is no necessity for a cement-mortar cushion. (10) The wearing surface, being semi-flexible, adjusts itself to slight changes in foundation conditions without damage, and to deflections in less rigid types of bases than concrete.

SNOW REMOVAL PLANS AND PROCEDURE

Considerable attention has been paid snow removal from highways since motor haulage of freight between cities has been employed to supplement transportation by rail. As the season is at hand when work of this kind must be done it is of timely interest to note the snow removal plans and procedure of the northern states as reported to Municipal and County Engineering by engineers of several of the state highway departments.

New York

Charles Van Amburgh, Third Deputy, New York State Commission of Highways, Albany, writes:

Our laws do not provide for any systematic treatment of this problem by the State Highway Commission. The law under which we are working at present was enacted before the construction of improved highways by the state had begun, and before present traffic conditions were dreamed of. As it now stands, this matter is left entirely to each town; the town boards are vested with authority to raise such sums as they may deem advisable for this purpose. The sums so raised are expected to cover the entire mileage of all the towns. The matter of determining the amount of work which shall be done on any highway improved, or unimproved, being left entirely to the discretion of the town superintendent of highways under advice of the town board.

In the western, central and northern portions of the state, very little attempt has been made to keep improved

highways open for motor vehicle traffic, as the expense thereof when borne by the town alone would be prohibitive.

In the southeastern portion where are located many wealthy towns, with a large percentage of improved mileage, and with a light snow fall and frequent thaws, the main improved highways have been kept open at the town expense which, under the physical conditions mentioned, is comparatively light.

In very many of the northern towns where the winters are long and severe and the snowfall heavy, frequently reaching a depth of 5 ft., snow rollers have been largely employed and make a very satisfactory road for sleighs drawn by horses, but these roads would be unsatisfactory for a large amount of automobiles, and practically impassable for the heavy motor trucks.

The total amount expended by the towns of the state for this purpose in the winter of 1918-19, was $537,707.67, but that winter in this state was very mild, and the snowfall light, and this expenditure much smaller than the average.

The legslature of this state in the spring of 1918 made an appropriation for snow removal on the so-called "Army Truck Routes" during the winter of 1918-19. Some of this appropriation was used successfully for this purpose, but the necessity for moving army trucks having passed, the balance of this appropriation reverted to the general funds of the state. It is now up to each town to keep their own highways open; the cost of doing this work to be paid from town funds raised by town tax for that purpose.

In doing the above mentioned work, some towns, or localities joined forces and used snow plows, sometimes in connection with a motor truck for power, others used horse-drawn road scrapers, while some relied on shovelers.

In the main cross state routes, some 19 miles of snow fence were built and erected during the fall of 1918. This proved very satisfactory and it will again be placed to protect badly drifting spots during the coming winter. We believe that many towns will construct more snow fence now that they have been made to see that it is a money saving method for eliminating this trouble.

When the time comes, if it is not already here, that the traffic demands upon our highways warrant a revision of our methods, a complete revision of legislation for this purpose will be necessary. The cost of maintaining the principal improved highways in a condition to permit automobile and auto truck traffic during the winter months by the towns unaided, is absolutely prohibitive. It would manifestly be as unjust to ask the towns to bear this burden individually as it would have been to ask them to have borne the entire cost of the original improvement of these highways. It would seem that the cost might be distributed very much as the cost of improvement was in the first instance; that is, by the state, county and towns, but so far as we know, no tentative plan of this kind has as yet been brought forward and it remains for the wisdom of future legislatures to work out the details and enact legislation which shall put in force some feasible plan.

Connecticut

W. Leroy Ulrich, Superintendent of Repairs, Connecticut Highway Commission, Hartford, writes:

The Trunk Line Roads in the state of Connecticut have been kept open for traffic since the winter of 1917. The work is handled by the same men and equipment used during the balance of the year to perform the various work necessary to keep the road surfaces in condition. The bulk of the work is accomplished by the use of snow plows attached to the front of automobile trucks owned by the department. At the present time we have about 50 of these snow plows and expect to have about 75 working this winter. In some of the sections horse-drawn road machines are used and in the others the road machines are attached to the back of trucks or hauled by tractors. The department is informed by the local weather bureaus upon the approach of storms and our men in the various sections are notified. The work is commenced when the snowfall reaches a depth of from 3 to 4 ins. and work is continued as long as snow falls and until the roads are open for ordinary traffic. On the main roads the snow is removed practically to the surface of the road; in some of the outlying districts where this would cause inconvenience to traffic, all but 3 ins. is removed and this is allowed to pack down so that sleds may be used. Under ordinary conditions traffic is delayed very little; under the most severe conditions the roads are usually open for traffic the day following the cessation of the storm.

Vermont

R. S. Currier, Asst. to Commissioner, Vermont State Highway Department, Montpelier, writes:

Under the law of the State of Vermont, this department has nothing to do with the question of snow removal, that being left entirely to the towns, cities and villages. There are no state funds available for this purpose.

Outside of the city and village streets, where a certain amount of snow is removed, the general method employed in Vermont is to roll the snow down with a snow roller and keep the traffic on top of it.

In places, where the snow has a tendency to drift, it is either controlled by snow fences or by shoveling out the drifts.

Rhode Island

I. W. Patterson, Chief Engineer, Rhode Island State Board of Public Roads, Providence, writes:

Our state highway law places the responsibility for the keeping of state roads open during the winter months with local authorities. This department, therefore, is unable to go into the matter of snow removal. We have attempted for several years to have our state highway law amended so that we might assume the responsibility for snow removal, but to date our efforts along these lines have been unavailing.

New Jersey

E. M. Vail, Maintenance Engineer, New Jersey State Highway Commission, Trenton, writes:

So far as the state highway department is concerned only a small mileage is now controlled by them, the larger mileage of roads being cared for directly by the counties.

The highway department is planning to purchase snow plows to be attached to the front of trucks which will be operated by state employes on state routes.

Delaware

Charles M. Upham, Chief Engineer, Delaware State Highway Department, Dover, writes:

Last year we prepared to remove snow from one of our main roads of travel, but at no time during the winter was there snow enough to bother with.

We are attaching snow plows to some of the auto trucks that have been turned over from the war department, and expect to keep our main routes of travel in the northern part of the state, opened up by these means. If we remove snow in the southern section of the state, it will undoubtedly be by horse power, using snow plows or road scrapers.

Pennsylvania

George H. Biles, Assistant Commissioner, Pennsylvania State Highway Department, Harrisburg, writes:

It is our intention to keep all of the main connected, hard surfaced highways open for Winter traffic, particularly those sections where motor trucks can be used for the transportation of farm products to the centers of population.

From our past experience, gained during the severe winter of 1917 and 1918, we made somewhat extensive plans to take care of the snow removal operations during the season of 1918 and 1919. Our intention was to use snow plows attached to department trucks, as well as road machines and wooden drags. We have purchased for this winter's operations 10 snow plow truck attachments in addition to the 16 already on hand. There are 225 road machines, property of this department, which will be transferred to the main lines of travel. The district organizations will handle this phase of the work the same as all of our general maintenance operations.

Of those particular highways where it is essential that they be opened up at the earliest possible moment we are transferring our truck equipment; the road machines to be used on roads of secondary importance and supplementing the truck equipment.

We have a caretaker on each section of from five to six miles in length, and he is given authority to hire additional labor if circumstances warrant.

The District Engineers and Superintendents will keep in touch with the prognostications of the Weather Department, in order that they may anticipate the snow storms and have their organizations in condition to take up the snow removal work as soon as the storm starts. We have arranged with the United States Weather Bureau to forward daily reports of the snow and road conditions, which will be published daily.

Ohio

A. H. Hinkle, Deputy Highway Commissioner of Ohio, Bureau of Maintenance and Repair, Columbus, writes:

Owing to the fact that our state law makes it the duty of the Township Trustees to remove snow from highways, our plans for doing this work cannot consist of much more than a campaign of education for encouraging the local officials to take up the work of snow removal on the principal thoroughfares of the state.

We have prepared a circular describing various methods of doing this work and illustrating various kinds of snow plows and equipment used for such purpose.

During the war we departed from the law to the extent of using state funds in keeping open the government truck routes across our state. We did this as a war emergency and owing to the fact that no large amount of funds were used for this purpose, we feel that no just criticism could be brought against the department. Whether or not we will venture to do some of this work this season is yet to be seen.

It is perhaps possible that some revisions may be made in the mentioned circular this year. The circular states that the causes of snow drifts frequently can be removed and a campaign of education throughout the country in regard to this fact would be a wonderful help in keeping open our roads for winter traffic.

Illinois

H. B. Bushnell, Maintenance Engineer, Illinois Division of Highways, Springfield, writes:

Snow removal on roads under state maintenance will be handled by maintenance foremen that are assigned to each district.

Our state is divided into 9 districts with a district engineer in charge of both maintenance and construction of all work within the district. Each district engineer has one or more maintenance crews and in addition to this, in a number of cases we have local men acting in the capacity of patrolmen.

We have a few snow plows rigged up to attach to trucks and we estimate that it will be possible to take care of the greater part of our snow removal with this equipment.

Iowa

W. H. Root, Engineer of Road Maintenance, Iowa State Highway Commission, Ames, writes:

The maintenance of the most traveled roads in this state is now handled directly by the county. This means that there will be as many plans for snow removal this winter as we have counties in the state. Commencing July 1, 1920, the maintenance of the Primary Road System will be directly supervised by the State Highway Commission. Very little attention has been paid to snow removal in this state in the past. The only machine which has been used to my knowledge has been the blade grader. The blade grader gave very good satisfaction where the snow was not too heavy.

Kansas

M. W. Watson, State Highway Eingineer, Topeka, writes:

We have made no definite plans for this work during the coming winter. I do not believe that Kansas is troubled as much with the removal of snow from the highways as many of the more northern and eastern states. Most of the counties have handled this work by the use of drags and the ordinary blade grader and when the cuts are deeper than these tools will handle effectively, snow has been removed by shoveling.

We have discussed the question at the meetings of our county engineers in a number of instances, but no conclusions have been reached whereby we could derive a better method than has been employed.

Nebraska

George E. Johnson, State Engineer, Lincoln, writes:

The 1919 legislature empowered this department to adequately maintain the roads included in the highway system, some 89 separate routes. This means that the coming season the State Highway Department will plan for the removal of the snow on all main highways of the state. Until that time, January 1, 1920, all that can

be done, will be to urge and advise the county commissioners and supervisors to remove the snow from the blocked roads throughout the state. After that time, maintenance systems will take care of the snow removal problem. Letters and bulletins of advice, together with co-operation, will probably clear the main highway systems.

Idaho

F. L. Drew, Maintenance Engineer, State Department of Public Works, Boise, writes:

The problem of snow removal has not been gone into very thoroughly as yet, and in all probability it will not be considered a serious factor until such time as traffic will have increased to a considerable extent.

At this writing a good portion of our highways will not be affected because of the fact that we have a very light snowfall in the southern portion of our state. In parts where snow is apt to drift it will be our policy to erect snow fences and thereby keep the cuts clear of snow.

In certain parts of the state where the snowfall is heavy, it will not be possible to make any provision for keeping the highways clear, as traffic will be carried on by means of sleighs more or less.

As for any organization to carry on this work, would say that we have not gone into it deeply enough to warrant any such procedure.

Colorado

J. E. Maloney, Chief Engineer, Denver, writes:

We have handled snow removal with the regular county maintenance outfits. There will be no changes this season. This applies, of course, to sections of the state except the roads over the Continental Divide, which it has not been found practical as yet to keep open during the heavy snows in winter.

RECLAMATION BY DRAINAGE OF LAND IN THE MISSISSIPPI VALLEY

By Edmund T. Perkins, President National Drainage Congress, Consulting and Supervising Engineer, 1211 First National Bank Bldg., Chicago, Ill.

The greatest opportunity in the United States today for the development and utilization of our natural resources lies in the Mississippi Valley. Nature has provided the opportunity and only the stupidity and slothfulness of mankind hinders the development of this valley to its utmost capacity.

The Opportunity

The greatest known system of navigable streams, flowing through the greatest valley in the world, a valley most productive in all things essential for the need and comforts of the world, centers here; and unified effort on the part of the states, the cities and the people of this valley, is the one thing needed to make it the great center of the world in production, wealth and population, and to bring the utmost prosperity to all the cities and people of the Mississippi Valley.

The Valley

The area of the valley is 1,240,050 square miles, a little less than 50 per cent. of the entire area of the United States, which is 3,026,789 square miles. In round figures the total area of all the countries of the European Belligerents excepting Russia, is 1,200,000 square miles, a little less than the area of the Mississippi Valley, and had our natural resources been fully developed, the wealth of this territory would have far exceeded the combined wealth of all the European belligerents.

The River Sytem

The Mississippi river starting at the Southwest Pass with its depth of 35 ft. comprises the following streams with approximate navigable depth:

The Mississippi river, New Orleans to Cairo, 1,000 miles with 9 ft. of water; Cairo to St. Louis, 250 miles, 8 ft of water; St. Louis to St. Paul, 700 miles, with 6 ft. of water. The Illinois river from Alton to Chicago, 230 miles, with 6 ft; the Ohio from Cairo to Pittsburgh, 945 miles, 6 ft. of water—but here there are being constructed

EDMUND T. PERKINS, CONSULTING ENGINEER.

37 locks costing $63,000,000 which will give between Cairo and Pittsburgh, a minimum depth of 9 ft. Cumberland river, 600 miles, 4 ft. of water; Tennessee, 800 miles, 4 ft. of water. Missouri river from St. Louis to Kansas City, 460 miles, 5 ft; Kansas City to Fort Benton, 1,700 miles further with an average depth of 4 ft. The Arkansas to Forsythe, Mo., 380 miles, with 4 ft.; to Muskogee, Okla., 480 miles, with 4 ft. The Red river to Denison, Texas, 800 miles, 4 ft. of water.

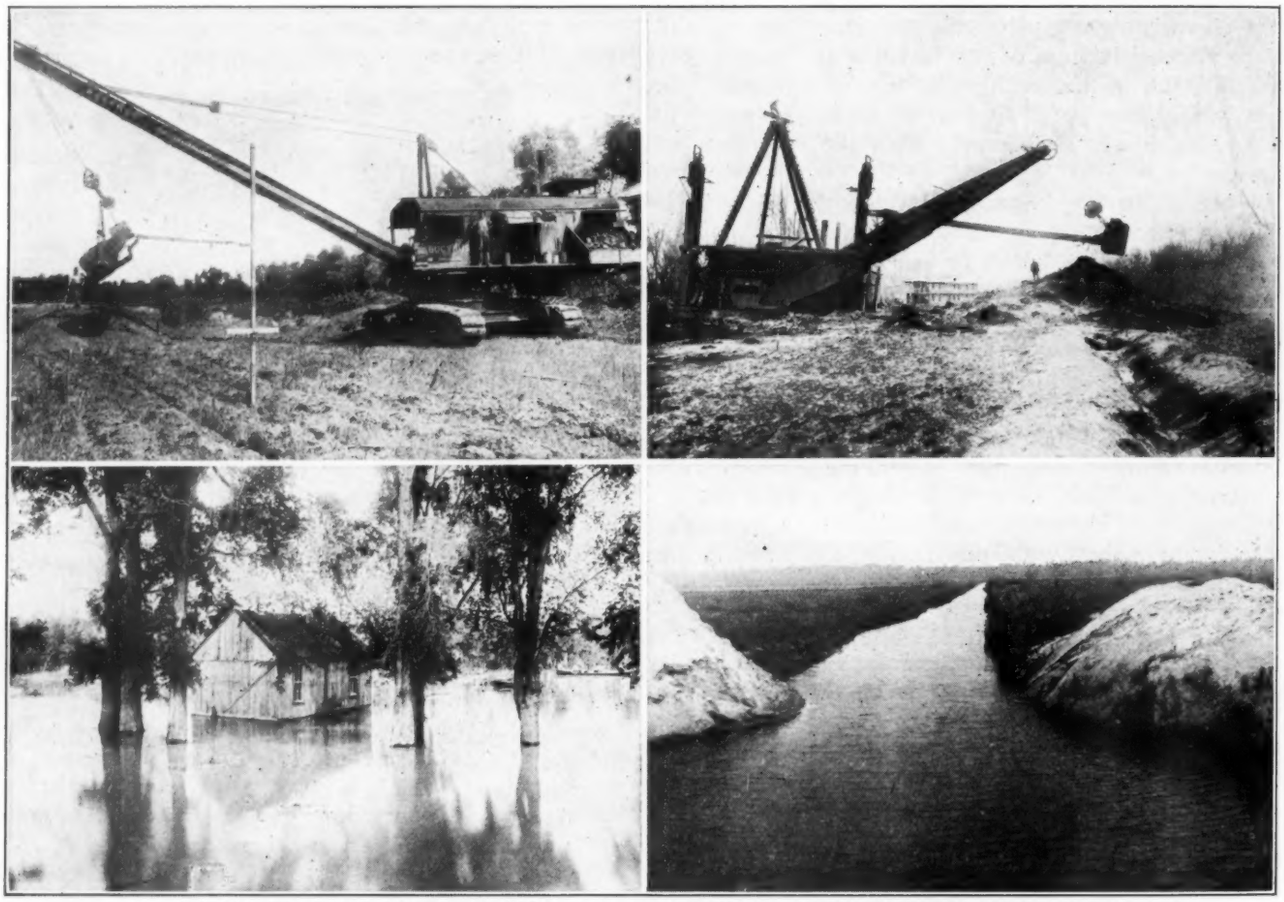
Water and Rail Transportation

In brief, of the 27,800 miles of navigable waterways in the United States, 15,000 miles comprise the Mississippi Valley system, and your knowledge of geography will tell you that this waterway system carries you from the trough of the Mississippi river on the west into Texas, Oklahoma, Kansas, Wyoming and Montana; on the east, through Alabama, Tennessee, Ohio, West Virginia into Pennsylvania, Ohio, Indiana and Illinois, so that there is no part of this valley that cannot be reached by water. As for other means of transportation, 50,000 miles of trunk line railroads are tributary to this valley with the best grades of any roads in the country. Moreover, the north and south railroad systems connect Chicago, St. Louis, Indianapolis and Pittsburgh with one another, with New Orleans and other ports, and intersect all transcontinental systems giving all parts of the valley access by

rail to every point of the interior of the United States, and when the river and rail have brought their load to the Gulf, there they find ocean harbors fitted to handle any amount of export business.

With the natural advantage of transportation all "down hill" to the Gulf and ports ready to handle any export business brought them, why should we not develop to our utmost the natural resources of this tributary region that our internal, our export and import business, and our profits may reach the ultimate degree?

Even now we find approximately 50 per cent. of population and of every product in the United States coming from the Mississippi Valley and with the wonderful natural resources of the valley fully developed, this percentage would amount to 85 or 90 per cent.



VIEWS SHOWING LAND RECLAMATION BY DRAINAGE IN THE MISSISSIPPI VALLEY.
Top Row: Dragline Levee Builder at Work, Green Bay Levee and Drainage District, Lee County, Iowa—Floating Dredge Levee Builder on same Project. Bottom Row: "Rainfall" Pumping Station Inadequate, Lima Lake Drainage District, Adams County, Ill.—Drainage Ditch on Wisner Estate, Inc., Raceland, La Fourche Parish, La.

In no other region of which I know, is there the opportunity for the reclamation and improvement of agricultural lands intimately tied up with the necessity; for navigable reasons, of controlling the streams which devastate these lands.

There are unreclaimed swamp and overflowed lands in these states classified as follows by the United States Department of Agriculture:

Classification of Unreclaimed Swamp and Overflowed Land

With reference to their productive value as affected by their natural wet condition, they may be classified as follows:

First, lands which are permanently wet and are never fit for cultivation, even during the most favorable years, nor afford profitable grazing for live stock.

Second, lands which afford pasturage for live stock, though the forage they produce may be of indifferent quality.

Third, lands which in their natural condition are subject to periodical overflow by streams, but which at other times produce valuable crops.

Fourth, lands which during seasons of light or medium rainfall will yield profitable crops, but which are wholly unproductive during the seasons characterized by a greater than the normal rainfall.

The following classification of the swamp and overflowed lands, with reference to these differences, represents approximately their relative agricultural value as affected by water conditions. All of these classes of land require draining to fit them for profitable cultivation, though a revenue of greater or less amount is periodically derived from all except the first class.

State	Permanent swamp Acres	Wet grazing land Acres	Periodically overflowed Acres	Periodically swampy Acres	Total Acres
Alabama	900,000	59,200	520,000	.....	1,479,200
Arkansas	5,200,000	50,000	531,000	131,300	5,912,300
California	1,000,000	1,000,000	1,420,000	.....	3,420,000
Connecticut	.....	10,000	20,000	.....	30,000
Delaware	50,000	50,000	27,000	200	127,200
Florida	18,000,000	.....	1,000,000	800,000	19,800,000
Georgia	1,000,000	.....	1,000,000	700,000	27,000,000
Illinois	25,000	500,000	400,000	.....	925,000
Indiana	15,000	100,000	500,000	10,000	625,000
Iowa	300,000	200,000	350,000	80,500	930,500

Kansas	.....	59,380	300,000	.....	359,380
Kentucky	.....	100,000	300,000	44,600	444,600
Louisiana	9,000,000	.....	1,196,605	.....	10,196,605
Maryland	100,000	.....	92,000	.....	192,000
Maine	156,520	.....	.....	.....	156,520
Massachusetts	20,000	.....	39,500	.....	59,500
Michigan	2,000,900	947,439	.....	.....	2,947,439
Minnesota	3,048,000	2,000,000	.....	784,308	5,832,308
Mississippi	3,000,000	.....	2,760,200	.....	5,760,200
Missouri	1,000,000	.....	1,439,600	.....	2,439,600
Nebraska	.....	100,000	412,100	.....	512,100
N. Hampshire	5,000	.....	7,700	.....	12,700
New Jersey	326,400	.....	.....	.....	326,400
New York	100,000	100,000	329,100	.....	529,100
No. Carolina	1,000,000	500,000	500,000	748,160	2,748,160
North Dakota	50,000	50,000	50,000	50,000	200,000
Ohio	.....	.....	100,000	55,047	155,047
Oklahoma	.....	.....	31,500	.....	31,500
Oregon	254,000	.....	.....	.....	254,000
Pennsylvania	.....	.....	50,000	.....	50,000
Rhode Island	.....	.....	6,000	2,064	8,064
So. Carolina	1,500,000	.....	622,120	1,000,000	3,122,120
South Dakota	100,000	.....	511,480	.....	611,480
Tennessee	639,600	.....	.....	.....	639,600
Texas	1,240,000	1,000,000	.....	.....	2,240,000
Vermont	15,000	.....	8,000	.....	23,000
Virginia	600,000	.....	200,000	.....	800,000
Washington	20,500	.....	.....	.....	20,500
W. Virginia	.....	.....	23,900	.....	23,900
Wisconsin	2,000,000	.....	.....	360,000	2,360,000
Total	52,665,020	6,826,019	14,747,805	4,766,179	79,005,023

In addition to the above total area of 79,005,023 acres of wet land, it is estimated that there are 150,000,000 acres of what is now known and occupied as farm land, which is too wet for the most profitable cultivation, and whose production would be increased 20 per cent. by proper drainage.

Present Value of Unreclaimed Lands—Malaria

Today these lands in general have only nominal values from $5 to $30 an acre, depending upon the frequency of their overflow, and on account of the swamp diseases which they generate they are a perpetual menace to the health of the nation, and a tremendous financial loss each year on account of the lessening of the man power of the nation. This loss Dr. W. A. Evans, former health commissioner of the city of Chicago and writer of health articles for many papers, has estimated as follows:

Loss through Malaria death per annum	$ 10,200,000
Cost of disability and illness from Malaria	192,000,000
Depreciation of real estate and loss in earning power of labor due to Malaria	60,000,000
Total annual economic loss due to Malaria	$162,200,000

In arriving at these estimates, Dr. Evans frequently cut in half the general accepted estimate. The terrible suffering that must be endured by humanity so long as Malaria is permitted to exist is a matter of the deepest concern to the whole nation.

River Regulation

To develop the natural resources of the Mississippi Valley, so that we may profit from Chicago, St. Louis and Minneapolis on the north, Pittsburgh on the east, Kansas City and Omaha on the west, St. Louis, Cairo, Memphis in the center of the valley to New Orleans and other gulf ports, it is necessary that our rivers be regulated and made navigable with proper terminal facilities, and facilities for exchanging freight to and from the railroads, that levees of proper height and section be built and maintained from Cape Girardeau to the south, and that the upper reaches of the river be regulated by every means possible, as for example by the proposed flood reservoirs on the Monongahela and Alleghany rivers, as sponsored by the Pittsburgh Flood Commission.

Levees and Reservoirs

For let me definitely state that as levees are absolutely essential and the only way for the controlling of the rivers through the south, reservoirs on the upper reaches of the river are equally essential. These problems of river regulation and flood protection are so great and so intricate that there is no one way of solving it. Every device known to the engineer must be used according to the demands and needs of each locality. To develop the streams, the lands, the electric powers and other natural resources of this Mississippi Valley would easily take all the engineering talent of the nation, and all the money that the nation could advance, for what though it cost a billion of dollars, for every dollar rightly spent, there should be an annual return of an equal amount.

These are figures which a few years ago would not only have been beyond the comprehension but beyond the thought of any one, but at least the war has done one thing, it has taught us to think in billions.

Results to be Accomplished

Were this development carried out we would accomplish the following results:

1. The construction under government supervision of navigation facilities vastly improving waterways, now used for transportation, and opening up for navigation thousands of miles of waterways not now navigable.

2. The creation in connection with such navigation of an enormous total of hydro-electric power for the making of nitrate fertilizer for the farmers of the Mississippi Valley, for railroad operation, for manufacturers, for dewatering of wet lands or irrigating of arid lands, and for making "electric steel" and other similar products.

3. The construction of great public works, to give immediate employment to labor and to capital.

4. The development of waste lands, arid, wet and cut-over, providing homes for thousands and making the population and wealth of the Mississippi Valley many times what it is at present.

5. The prevention of destructive floods by river regulation.

6. An improvement in the public health worth millions yearly to the valley.

For a National Department of Public Works

To accomplish this work and to accomplish similar work, throughout the United States, there should be a National Department of Public Works, and daily we see in the papers, some organization demanding such a department, and until there is such a department, the development of the United States and of the Mississippi Valley will be continually hampered and will be done by piece-meal as it is done now, so let me urge upon the readers of Municipal and County Engineering in all parts of this great region, that we demand of our representatives in Washington and of the National Government, the creation of this department and the allotment to it of funds sufficient to develop for health, wealth and prosperity, for internal use and for export, the natural resources of the Mississippi Valley.

SEWAGE TREATMENT PLANT AT MONTEZUMA, IOWA

By J. H. Dunlap, Assoc. Prof. Hydraulic and Sanitary Engineering, State University of Iowa, Iowa City, Ia.

The town of Montezuma has had under construction since July 27, 1918, a sewage treatment plant consisting of a sedimentation tank of the Imhoff type, a siphon chamber, two intermittent sand filters and a sludge bed. The plant is now nearly completed, and when put into operation, will mark the end of a long-continued nuisance. For many years the town has discharged its sewage into a small creek which was practically dry in summer. During the hot, dry period of the year, this creek

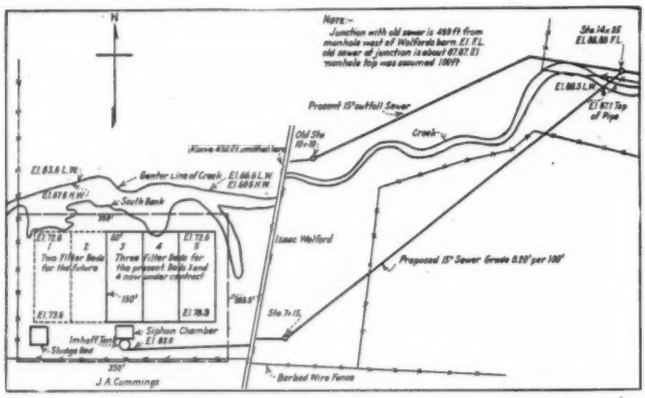


FIG. 1. GENERAL PLAN OF SEWAGE TREATMENT PLANT AT MONTEZUMA, IOWA.

became an open septic tank full of black, foul, ill-smelling, septic sewage. The milk cows in the adjoining pastures found it a favorite pastime to splash in this open septic tank in order to cool themselves and drive away the flies.

The description of the work thus far accomplished in Montezuma falls naturally into three divisions; one, the relation of the design of the plant to the funds available; two, the features of the plant as finally designed; three, the unit costs of the work to date.

Relation of the Design of the Plant to the Funds Available

The county auditor of Poweshiek County reported that the actual value in 1917, without moneys and credits, of the taxable property of Montezuma was $1,075,584. This represented a taxable value of $268,896. Each mill of tax levy would therefore amount to $268.896. Since Montezuma is an incorporated town, it has the power under section 840-g, supplemental to the code of Iowa, 1915, to levy annually a tax not to exceed five mills on the dollar for the purpose of constructing sewer outlets and sewage treatment plants. The income from this may be anticipated by issuing bonds. While there is no legal limit to the number of years for which this five mill levy may be anticipated, yet it is usually considered unwise and uneconomical to extend the period of years over more than twenty.

In finding the total amount of bond issue which an annual income of $1,344.48 from the five mill levy would make possible over a period of twenty years, it is very convenient to use the following simple formula:

$$B = \frac{T}{F}$$

B = amount of bond issue

T = annual income from taxes

$$F = \frac{r}{(1+r)^{n-1}} + r = \text{interest factor}$$

r = rate of interest

n = number of years to final payment of bonds

In Table I is given a set of interest factors for rates of interest of 5, 5½ and 6 per cent., and for 20 and 10 years to final payment of bonds.

TABLE I—INTEREST FACTORS.

r	n	F
5	20	0.0803
5½	20	0.0837
6	20	0.0872
5	10	0.130
5½	10	0.133
6	10	0.136

Using a rate of interest of 5½ per cent., the rate at which the bonds were finally sold, the possible bond issue over a period of 20 years becomes $16,060, as follows:

$$B = \frac{T}{F} = \frac{\$1,344.48}{0.0837} = \$16,060$$

It will be observed that this method of determining the amount of bond issue employs the equal annual payment method, which supposes that each year there is deposited in the bank at compound interest equal annual payments with the amount of the loan remaining constant until paid at the end of 20 years by the fund accumulated from the equal annual payments and the compound interest.

In Table II it is shown that the amount of the bond issue possible is the same whether there is deposited annually equal payments in the bank at compound interest, or whether an increasing payment is used to retire part of the loan until the loan is entirely paid at the end of 20 years. For convenience in calculation, $16,000 is used as the amount of the bond issue and $1,340 as the annual income from the five mill tax. It is believed that the results of only three years are necessary to show that the amount of the bond issue possible is the same under either plan of payment.

TABLE II—TOTAL ON DEPOSIT AT THE BANK WITH EQUAL ANNUAL PAYMENTS AT COMPOUND INTEREST—THE AMOUNT OF THE BONDS REMAINING CONSTANT UNTIL PAID AT END OF 20 YEARS BY THE ACCUMULATED FUND.

At end of year	Amount of bonds interest during unpaid drawing current year	Annual income from 5 mill tax	Interest on bonds at 5½%	Annual payment	Interest on annual payments at 5½%	Interest on interest at 5½%	Total on deposit at the bank	Total paid on bonds
1	$16000	$1340	$880	$460	$0.00	$0.00	$460.00	$0.00
2	16000	1340	880	460	25.30	0.00	945.30	0.00
3	16000	1340	880	460	50.60	1.39	1457.29	0.00
etc., etc.								

Total paid on the bonds with increasing annual payments used to retire part of the bonds annually until entirely paid at end of 20 years.

1	$16000	$1340	$880	$460	$460.00
2	15540	1340	854.70	485.30	945.30
3	15054.70	1340	828.01	511.99	1457.29
etc., etc.					

It will be observed in Table II that the total sum on deposit at the bank under the equal annual payment method is the same as the total paid on the bonds under

the usual plan of increasing annual payments to the bonding company. If the usual plan is employed of making increasing annual payments to retire part of the bond issue, in the first year $460 of bonds might be retired, in the second year $485.30 of bonds and in the third year $511.99 of bonds. Naturally no bonding company wishes to handle bonds of such amounts as these. The proposition of The White Company of Davenport was accepted by the town council that 31 bonds be issued, each for $500, rate of interest 5½ per cent. payable semi-annually, plus $125 for the expense of printing and issuing the bonds, 4 per cent. interest to be paid by the company on the principal on deposit until drawn by the council.

Since about $18,000 to $20,000 would be required to finance the plant, other sources of revenue had to be

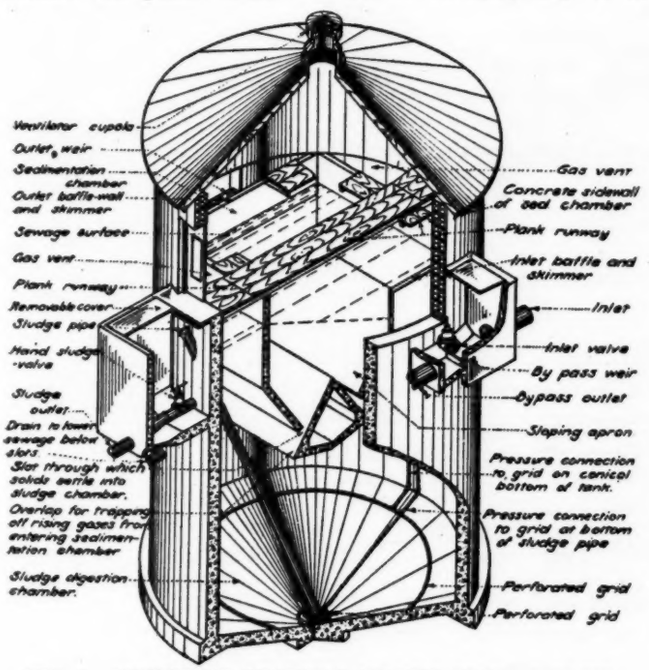


FIG. 2. ISOMETRIC DRAWING OF THE IMHOFF TANK, SEWAGE TREATMENT PLANT AT MONTEZUMA, IOWA.

found and the allowable indebtedness investigated. The constitutional limit of indebtedness in Iowa is 5 per cent. of the actual value of the taxable property. With a taxable value of $268,896 and therefore an actual value of four times this amount, $1,075,584, the allowable constitutional limit of indebtedness was $53,779.20. In view of the present bonded indebtedness of $24,886.73, this meant an allowable increase of indebtedness of $28,892.47.

Certain other facts need to be kept in mind in considering limits of indebtedness and bond issues in Iowa. General bonds, on the one hand, may be authorized by resolution of the council when the indebtedness caused thereby is less than 1¼ per cent. of the actual value of the taxable property. When the indebtedness is from 1¼ per cent. to 5 per cent. of the actual value of the taxable property, the bond issue must be approved by a vote at an election called on the petition of a majority of the voters. Such general bonds may be paid off at will and usually no definite plan for paying them off is adopted.

Special levy bonds, on the other hand, are issued for a definite period of time and do not need a vote at a general election from 1¼ per cent. to 5 per cent. of the indebtedness in any courts. Furthermore, the Iowa State Supreme Court has held that such bonds are not part of the constitutional debt of the city whether below or above 5 per cent. The main idea in the mind of the court seemed to be that under the law the town is not liable, in case it fails to levy or collect the tax specified. Hence, such bonds are not a debt. Furthermore, as each annual installment payment on the bonds become due, and therefore a debt, it is paid. In the Federal Courts, however, such bonds are held to be part of the debt, else the Federal Court has ruled there would be no limit to the amount of bonds for which councils might contract. Accordingly, it should be remembered that up to an indebtedness of 5 per cent., special levy bonds contracted for by town councils are good in all courts. Beyond an indebtedness of 5 per cent., however, such bonds are good only in Iowa. Moreover, such bonds issued in anticipation of special levies may be sold at any time, while bonds sold in anticipation of the two mill regular sewer tax, may be sold only after a definite certified cost of the work is on file and then only for a maximum period of ten years' anticipation.

One additional fact is of importance. By act of the Thirty-Seventh Assembly, approved March 28, 1917, no indebtedness which is incurred by cities and incorporated towns for the purpose of purchasing, erecting, extending or maintaining and operating water works, electric light and power plants, gas works and heating plants, or of building and constructing sewers, shall be charged against or counted as a part of the 1¼ per cent. available for general and ordinary purposes on resolution of the council until the other 3¾ per cent. available for the special purposes enumerated, has been exhausted. Luckily the law provides that after ninety days, injunctions due to illegal proceedings may not be granted.

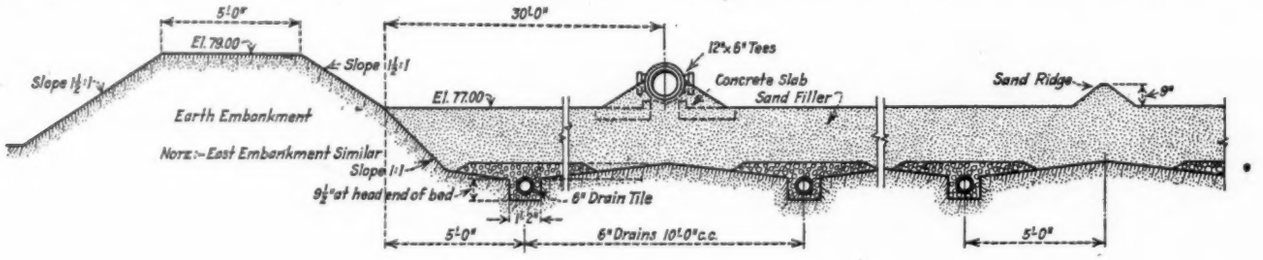
Putting all these facts together, it was determined that a sewage treatment plant could be easily financed within the constitutional limit of indebtedness of the city, which would enable the bonds to be sold in any state. However, since only $15,500 of the cost could be defrayed by the special five mill levy, other sources of revenue had to be found. Two sources were possible. The regular sewer levy of two mills might be anticipated over a period of ten years, making possible bonds for $4,050, as follows:

$$B = \frac{T}{F} = \frac{2 \times 268.896}{0.133} = \$4{,}050$$

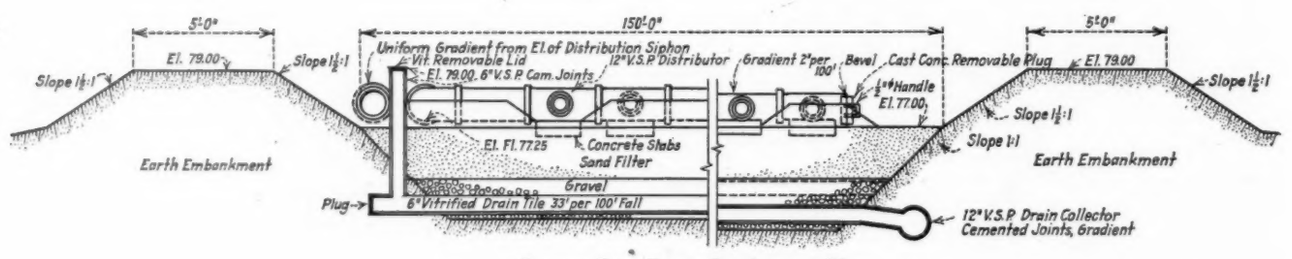
This, however, would leave the town without any funds for maintenance of its sewer system and its sewage treatment plant, except drafts upon the general funds which are apt to be hard pressed without this added burden. Accordingly, the plan of The White Company, as decided upon, is to supply whatever further funds are needed, in addition to the $15,500 already contracted for under the five mill levy, by making a general funding bond issue for an indefinite term of years. This can be authorized by resolution of the council in case the character of the present debt of the town is such that all of the 1¼ per cent. available for general purposes is not exhausted, when the debts properly chargeable to the 3¾ per cent. available for the special purposes above given are so allocated.

If the town had been constructing a general sanitary sewer system at the same time as its sewage treatment plant, then all or a part of the cost of the sewage treatment plant might have been assessed against the property affected, in conformity with the legal provisions relating to the assessment of the costs of sewers against the property. An act authorizing this was passed by the Thirty-Seventh General Assembly April 12, 1917.

Due to the fact that the special five mill levy would amount to a practicable bond issue of $15,500, it was necessary to design the plant so that the cost would not greatly exceed this amount. The contract cost of the plant was $16,100 with M. Tschirgi and Sons of Cedar Rapids successful bidders. With the cost of engineering, legal services, land and extras, the total cost of the plant will probably be about $18,000. This will leave about $2,500 to be raised by general funding bonds. The amount of money available limited the number of filter beds which could be constructed at this time. The two beds under contract will care for the sewage at the present time with no provision for the future. While an extra filter bed would have been a good investment if the funds had been sufficient, yet it seemed far better to make a beginning and take care of the present problem, at least, in hope that changes in the law might make possible additional special levies.



SECTION THRU FILTER BED LOOKING NORTH



SECTION THRU FILTER BED LOOKING WEST

FIG. 3. TYPICAL SECTIONS THROUGH THE FILTER BEDS OF MONTEZUMA, IOWA, SEWAGE TREATMENT PLANT.

The Features of the Plant as Finally Designed

Fig. I shows the general plan of the sewage treatment plant. The old sewer was a 15 in. vitrified tile sewer with uncemented joints. It discharged directly into the creek at a point just above the site selected for the sewage treatment plant. In order to obtain sufficient elevation of flow line to carry the sewage through the plant, it was decided to take up and relay the old 15 in. sewer, beginning at a point about 975 ft. from the old outlet. A junction manhole was built at this point and a new 15 in. sewer on a grade of 0.2 per cent. was laid for a distance of approximately, 1,425 ft. to the inlet manhole at the Imhoff tank. After sedimentation in the Imhoff tank, the sewage is automatically discharged by two alternating siphons upon the two filter beds. It was possible to locate the sludge bed at the southwest corner, as shown.

The Imhoff Tank

In designing the Imhoff tank, the first problem was to decide upon what the population of Montezuma might be 25 years hence. With a population of 1,326 in 1915, it was decided, after careful consideration of the growth of the town since 1885, that it was fair to assume 2,000 in the design of the tank. In Table III are given the settling periods in the Imhoff tank when the estimated average yearly flow of sewage, namely, 50 gals. per capita per day, occurs; and also the settling periods when 50 additional gals. per capita per day of ground water infiltration are reaching the sewers, making a total of 100 gals. per capita per day. It is believed that a population of 1,200 is likely to be connected to the sewers within the next five years, there being from 800 to 1,000 now connected. The settling periods, assuming the sewage to be evenly distributed over the 24 hours of the day, are compared with the settling periods with the flow evenly distributed over 18 hours of the day, as is commonly assumed in design.

TABLE III—SETTLING PERIODS IN THE IMHOFF TANK AT MONTEZUMA, IOWA.

Population connected to sewers	50 Gals. per capita per day		100 Gals per capita per day	
	Hrs. settling 24 Hrs. basis	Hrs. settling 18 Hrs. basis	Hrs. settling 24 Hrs. basis	Hrs. settling 18 Hrs. basis
1,200	4.85	3.65	2.42	1.82
2,000	2.91	2.18	1.45	1.09

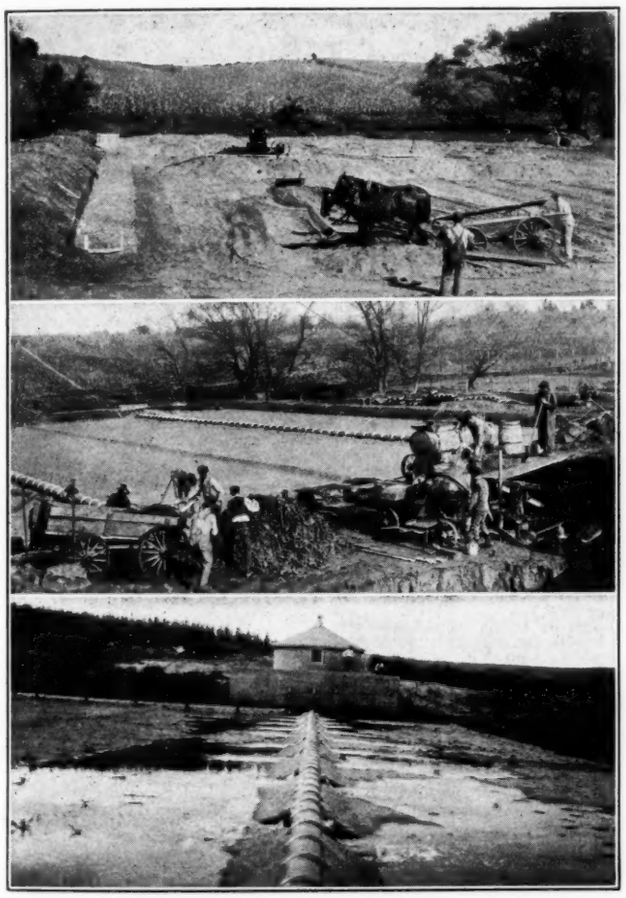
The area of the gas vents is 23.6 per cent. of the whole superficial area of the tank.

The sludge storage capacity up to within 3 ins. of the bottom of the beam forming the overlaps for the vents, is about 1.67 cu. ft. per capita on a basis of 2,000 future population, and up to the slots is about 1.88 cu. ft. per capita.

It will be observed that a relatively short flowing through period, with ample gas vent area and sludge storage capacity has been obtained in the design. The sewage from the town is fresh, domestic sewage readily

settleable. Due to the usual failure to keep the gas vent areas free from gas lifted sludge and to remove sludge from the sludge digestion chamber, it was decided that ample dimensions in these respects were necessary.

Reference to Fig. 2 will show the principal features of the Imhoff tank. In the inlet manhole, it should be noted that a by-pass weir is provided. The elevation of the crest of this weir may be made whatever experience shows is best, in order to allow only the proper amount of sewage to pass through the tank over upon the filter beds. Quantities in excess of this predetermined amount will automatically pass directly over the weir and through the by-pass outlet to the creek. In case it is desired to



VIEWS OF FILTER BEDS OF MONTEZUMA, IOWA, SEWAGE TREATMENT PLANT.
FIG. 4. (TOP) DISTRIBUTING SAND OVER THE GRAVELLED TRENCHES.
FIG. 5. THE FILTER BEDS DEC. 17, 1918.
FIG. 6. A DOSE OF SEWAGE FLOODING THE WEST FILTER OF THE COMPLETED PLANT.

by-pass the entire flow of sewage, the inlet valve may be closed and part of the by-pass weir removed, in order to give a clean sweep through the inlet manhole into the by-pass outlet.

The general inside dimensions of the tank are 20 ft. diameter, 24 ft. of depth to the base of the inverted cone with 5 ft. to the apex of the cone.

Two 8 in. slots with 8 in. laps are provided at the bottom of the settling chamber. Double slots should distribute the sludge more evenly in the sludge digestion chamber, assist somewhat in preventing stoppages due to imperfect operation, and decrease the room available for sludge. The sludge pipe is an 8 in. cast iron pipe extending to the bottom of the cone in the sludge digestion chamber. The hydraulic head on the gate-valve on the sludge pipe is 5 ft., which will enable the sludge to be discharged under the head of the sewage above. From the sludge manhole, a 10 in. vitrified pipe sludge line runs directly to the sludge bed. Two pressure connections are provided by means of which water or sewage under pressure may be pumped into the sludge at the bottom of the sludge digestion chamber, in case the sludge becomes so compacted that it will not flow through the sludge pipe. The pump is not to be installed now, but the pipe connections are to be put in so as to be ready for use at any time experience may show agitation of the sludge to be necessary.

One important and rather new feature provided in this tank, is the 8 in. drain visible in Fig. 2, just below the sludge outlet manhole. The flow line of this drain is such that the sewage may readily be drawn down below the slots in case it becomes necessary to work upon the walls of the settling chamber. It has been found in actual operation of Imhoff tanks in towns of the size of Montezuma, that not infrequently the sedimentation chamber is allowed to become completely sludged up and thus transformed into a small septic tank. In order to clean out the sedimentation chamber, it has been found necessary to lower the sewage below the slots and then force the sludge down through the slots, carefully squeegeeing the walls and sloping aprons.

Plank runways are provided over the tank in such a manner as not to interfere with squeegeeing the side walls and slopes of the settling chamber which is likely to be necessary frequently.

The tank has a superstructure of hollow building tile, to be plastered with cement mortar finished to resemble concrete. Two four-light sash doors are provided, one on the east and one on the west. A nine-light window on the north will admit additional light and air.

Siphon Chamber

The inside dimensions of the reinforced concrete siphon chamber are 32 ft. 6 in. x 26 ft. x 7 ft. It was designed of such area that when the sewage is 3 ft. deep, it will automatically discharge enough sewage to cover one filter bed to a depth of 3 ins. The siphons have a drawdown of 2 ft. 8 in.

Two alternating 10 in. siphons are to be installed under the present contract together with the main trap for a third siphon, so that when the third filter bed is added in the near future, the third siphon may be connected without breaking the concrete floor and side wall of the chamber. These siphons have been so located that five may ultimately be installed.

In designing the siphon chamber, an effort was made to insure plenty of head room, light and air for convenience in operation. At the southwest corner of the siphon chamber are two gate valves, one an 8 in. valve to convey the sludge that settles upon the floor of the siphon chamber to the sludge bed, and the other a 12 in. valve to be used when it is necessary to by-pass the sewage around the filters, but through the Imhoff tank. The stems of these valves extend up through pipe sleeves above the roof of the siphon chamber.

The Filter Beds

Two sand filter beds are included in the present contract. Each filter has an area of 60 ft. x 150 ft. On the basis of 200,000 gals. per acre per day, one-half ground water in wet periods, each filter will care for about 400 people. Ultimately five beds will be constructed, thus providing for a population of 2,000, the capacity of the Imhoff tank.

Fig. 3 shows the method of construction employed. On each bed a 12 in. vitrified sewer pipe distributor with 6 in. tees distributes the sewage over sand two feet deep, under which graveled trenches containing 6 in. vitrified drain tile, 10 ft. center to center.

Fig. 4 shows the method used in graveling the trenches and is distributing the filter sand. Every precaution was taken to prevent heavily loaded wagons from passing over the graveled trenches. The sand was dumped, first, at the north end of the filters upon a plank roadway. An ordinary gasoline driven back-filling machine, with a sand buck, was used to distribute the sand over the north half of the filter beds. Then the same general procedure was repeated at the south end of the filter beds. The concrete collector manhole at the northwest corner of the filter beds is clearly visible in Fig. 4. Into this collector manhole come the collector headers into which the 6-in. underdrains run. The 15 in. by-pass, together with the sludge drain from the sludge bed, also comes into this collector manhole. From the manhole one 15 in. outlet runs to the creek bank where a substantial concrete head wall has been constructed. When the two beds are added at the west, their collector header will also come into the west side of the collector manhole where the first length of pipe has already been set.

In Fig. 5 are shown the two filter beds nearly completed on December 17, 1918. The 12 in. distributors with the 6 in. tees are clearly to be seen. The 5 ft. berms around the filter beds have been sodded.

In the foreground is the edge of the cave-in of the Imhoff tank excavation. The contractor did not exercise sufficient precaution in speeding up the excavation of the 30 ft. hole for the Imhoff tank. Accordingly, he was subjected to great expense due to several successive cave-ins. In the middle foreground is seen the area nearly ready for the floor of the siphon chamber.

The Sludge Bed

The sludge bed is 30 ft. x 40 ft. Its construction, while in general similar to that of the filters, differs in the depth of the filtering material. The sludge bed ought to be made as porous as possible in order to drain away the liquid from the sludge quickly. Accordingly, a surface layer of filter sand 6 ins. in depth has been placed upon the gravel layer, which has been made about 1 ft. in depth, or double the depth of the gravel layer in the filters. The 10 in. vitrified sludge pipe from the Imhoff tank has been given a sharp grade from the tank, in order to prevent an unnecessary number of stoppages. The elevation of the flow line at the outlet of the sludge pipe has been placed 1 ft. above the surface of the sand in order that the sludge may be run out, if necessary, to a depth of 1 ft. over the sand before beginning to back up in the sludge pipe. It is believed that it will never be necessary to run out from the tank at any one time more than 1 ft. of sludge. It is better practice to run out small amounts of sludge every two to six weeks.

Unit Costs to Date

The unit costs are based on labor at $4 per day of 10 hours until late fall, when the cost was $4 per day of 8 hours; teams at $7 per day of 10 hours, and later per day of 8 hours. The length of haul from the railroad siding to the plant was 1.3 miles, over a fair road with no up-grades. The costs do not include superintendence, overhead and profit.

EARTH WORK

Type		Estimated cu. yds.	Cost per cu. yd.
Filter beds	Slip work	1060	$0.47
Siphon chamber	½ slip and ½ hand	187	0.78
Imhoff tank	Hand before banks caved	408	0.82
Imhoff tank	After cave-ins with bracing	408	2.70

Sodding berms of filter beds, $0.20½ per sq. yd.

COST OF FILTER SAND

Cost per ton F. O. B. sand company	$0.35
Freight	0.90
Unloading from cars, mostly box cars	0.063
Hauling by team 1.3 miles	0.39
Unloading from wagons	0.022
Leveling and spreading	0.131
Total cost per ton in place	$1.86
Total cost per cu. yd. of 3,000 lbs	2.78
Total required for two beds	1,390 cu. yds.
Total required for sludge bed	21 cu. yds.

COST OF FILTER GRAVEL.

Cost per ton F. O. B. gravel company	$1.25
Freight	0.90
Unloading from cars, mostly box cars	0.095
Hauling by team 1.3 miles	0.39
Unloading from wagons	0.022
Total cost per ton at filter bed	$2.66
Total cost per cu. yd. of 2,700 lbs	3.59
Total required for two beds	194 cu. yds.
Total required for sludge bed	32 cu. yds.

COST OF 1:2:4 CONCRETE IN CYLINDRICAL WALLS OF IMHOFF TANK, PER CU. YD.

Cement at 6.4 sacks per cu. yd. F. O. B. Montezuma ($2.28 per bbl.)	$3.65
Hauling by team 1.3 miles—to barn 8½c, to job 9c	0.18
Sand, 0.45 cu. yd. at $2.65	1.19
Gravel, 0.90 cu. yd. at $3.59	3.23
Steel reinforcement	1.49
Setting forms and reinforcement	2.93
Mixing and pouring—heating sand, gravel and water	1.98
Total cost per cu. yd. in place	$14.65

COST OF 1:2:4 CONCRETE IN SIPHON CHAMBER PER CU. YD.

(Includes only walls and footings; roof and floor omitted.)

Cement at 6.4 sacks per cu. yd. F. O. B. Montezuma ($2.28 per bbl.)	$3.65
Hauling by team 1.3 miles—to barn 8½c, to job 9c	0.18
Sand, 0.45 cu. yd. at $2.65	1.19
Gravel, 0.90 cu. yd. at $3.59	3.23
Steel reinforcement	1.59
Setting forms and reinforcement	2.18
Mixing and pouring—heating sand, gravel and water	1.65
Total cost per cu. yd. in place	$13.67

COST OF 6 IN. VITRIFIED FARM DRAIN TILE IN FILTER BEDS

Cost of tile per ft. F. O. B. Montezuma	$0.08
Hauling by team 1.3 miles	0.005
Trenching	0.039
Laying	0.01
Graveling at $2.66 per ton and spreading at $0.04 per ft.	0.44
Total cost per ft. of trench	$0.574

LAYING 15-IN. VITRIFIED PIPE SEWER MAIN, 1,425 FT. IN LENGTH

Cost of pipe per ft. F. O. B. Montezuma	$0.65
Hauling by team 1.3 miles	0.033
Trenching, including back-filling	0.376
Laying, including mortar	0.077
Total cost per ft. of trench	$1.14
Cost of taking up old 15-in. sewer and back-filling per ft.	$0.246

Acknowledgment

The foregoing article by Prof. Dunlap is reprinted from The Transit, Vol. 23, 1919.

Galveston's oyster-shell streets successfully surfaced with Tarvia

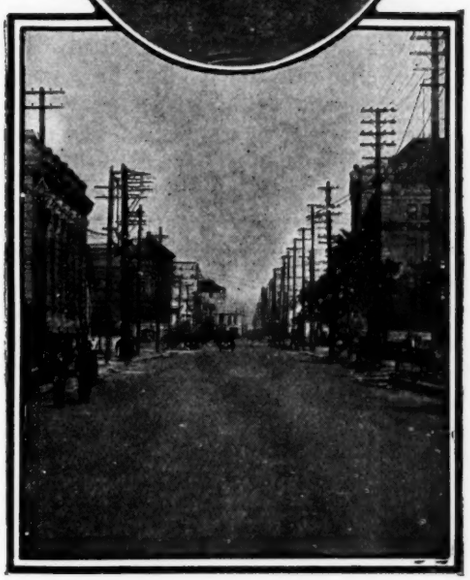
WE have repeatedly claimed that there is a grade of Tarvia and a method of application that will solve practically any road problem—and solve it economically.

Now comes a letter from George H. Willits, City Engineer of Galveston, Texas, telling how Tarvia has improved that city's oyster-shell streets, and at the same time reduced maintenance expense. A portion of Mr. Willits' letter follows:

"Practically *all* of Galveston's streets, outside of the business district, are built of rotted oyster shell, commonly called mudshell. This shell is easily compacted into a smooth, hard road surface which looks very much like concrete. However, this surface will not withstand wet weather nor the abrasion of heavy traffic, becoming very dusty in summer and on account of its white color, causing a disagreeable glare, and in the rainy season soon becoming muddy and full of holes.

"In May, 1917, we began surface treating these shell streets with 'Tarvia-B' and 'A' and trap rock, and have had very fine results from this work. Our streets stay in good surface during all kinds of weather; we have eliminated heavy maintenance bills for shell and do not find it necessary to sprinkle these treated streets as we are compelled to do all untreated shell streets for eight months in the year. The dark color of the Tarvia surface entirely eliminates the disagreeable glare.

"The people of Galveston are very much pleased with the results obtained by surfacing the streets with Tarvia and testify to this by always seeking the treated streets for the heaviest travel."



Three views of the oyster-shell roads in Galveston, Texas, surface-treated in 1917 with "Tarvia-B" and "A." At top are shown 35th Street and Broadway. Lower view shows 20th Street, in the business section of the city.

Illustrated booklet free on request.

We believe we may safely say that no matter *what* kind of a road problem you are facing, Tarvia will help you in the solution—and save you money, too.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

Tarvia

Preserves Roads—Prevents Dust

THE BARRETT COMPANY, Limited: New York, Cleveland, Birmingham, Seattle, Youngstown, Chicago, Cincinnati, Kansas City, Peoria, Toledo, Montreal, Philadelphia, Pittsburgh, Minneapolis, Atlanta, Columbus, Toronto

The Barrett Company: Duluth, Richmond, Winnipeg, Milwaukee, Latrobe, Vancouver, Dallas, Bangor, Bethlehem, St. John, N.B., Boston, Detroit, Nashville, Washington, Elizabeth, St. Louis, New Orleans, Salt Lake City, Johnstown, Buffalo, Halifax, N.S., Baltimore, Lebanon, Sydney, N.S.

TRADE B MARK

PERSONAL ITEMS

Harry Barker and Robert C. Wheeler announce their association for the practice of engineering and the establishment of an office at 1512 Maiden Lane Building, 170 Broadway, New York City. Mr. Barker has recently been released from military service as Captain of Engineers, U. S. A., but Major Wheeler will remain in the service for a short time as Chief of the Water Supply Section of the Construction Division of the Army. Mr. Barker will be the active director of the firm's work until the release of Major Wheeler.

Special attention will be given to public utility engineering, including valuations, rates, operation and management; to hydraulics; to power development and utilization; water supply and purification; sewerage and sewage disposal; municipal problems, including city transportation and civic improvements; development of new processes; and reports for investors.

Mr. Barker is a graduate engineer (University of Vermont), with over fifteen years broad experience in electrical, mechanical and civil fields. His earlier work included design and testing of power plants, and field and laboratory work in hydraulics. For several years he was an editor of "Engineering News" and "Engineering News-Record," making critical studies of a wide variety of engineering works and particularly of power development and utilization, pumping plants, water works, public utility valuations and rate cases, transportation and other municipal problems. From the early days of the present form of utility regulation he has been consulted in public utility matters and much of his experience has been collected in the treatise "Public Utility Rates," published in 1917 by the McGraw-Hill Book Co., New York. In 1917 Mr. Barker was called from reserve to active military service, being assistant engineer depot officer at the New York Port of Embarkation, and an engineer of camp maintenance and utility operation in the Cantonment and Construction Divisions. After the armistice he was given leave to become associated with Mr. George W. Fuller, member of the Engineers' Valuation Board for the Pittsburgh Railways, which Board assisted the Pennsylvania Public Service Commission in the valuation of the 600-mile street and interurban railway system of the Pittsburgh District.

Mr. Wheeler is a graduate engineer (University of Vermont), who has specialized for ten years in the design, construction and operation of water supply and purification plants, sewers and sewage disposal works. His earlier work was in railroad construction. For over five years he was associated with Mr. George W. Fuller, being particularly identified with the water works and sewerage improvements at Clarksburgh, W. Va., the sewerage and sewage disposal works at Vincennes, Ind., and those for Plainfield, North Plainfield and Dunnellen, N. J. Later he served a term as City Engineer for Summit, N. J., and then became General Manager and Chief Engineer of the New Chester Water Co., of Chester, Pa., and its subsidiaries, the Greencastle Water Co., Greencastle, Ind., the Vincennes Water Supply Co., Vincennes, Ind., and the Delaware Water Supply Co., Delaware, Ind. This office he resigned in August, 1918, when commissioned Captain in the Construction Division of the Army. He served as Assistant Port Utilities Officer at Newport News, Va., and in June, 1919, was promoted and assigned as Chief of the Water Supply Section.

Mr. E. J. Dewine, who for the past two years has been in the Construction Division of the U. S. Army, has joined the International Exposition of Municipal Equipment, New York City, to take charge of the department of streets, asphalt and road machinery. Mr. Dewine has had a wide and varied experience in this field, having begun his experience in 1895 with the Warren-Scharf Asphalt Paving Co., which finally developed into Warren Bros. In 1900 he joined the Southern Paving Construction Co., and for eight years was associated with them, and the jointly owned Southern Clay Mfg. Co. In the succeeding years he was identified with the Southern Contracting Co., the road department of the Barrett Co., and the U. S. Asphalt Refining Co. Mr. Dewine combines with a thorough knowledge of his profession, exceedingly large following.

Mr. J. H. Brewster has joined the staff of the International Exposition of Municipal Equipment, New York City. He is a well known sanitary engineer, and since his discharge from the army has been identified with the engineering department of the New York State Board of Health, where he had direct supervision of the investigation of plants producing milk or milk products, including investigation and reports of plants, design and construction and general equipment installed. After completing his course in chemical and sanitary engineering at the Rensselaer Polytechnical Institute, Mr. Brewster was connected with the American Water Works and Electric Co., of New York City for nearly four years as sanitary engineer, having charge of the operation of water purification plants. Later he joined the Indiana State Board of Health for four years. There his work included the approval of plans for water and sewerage systems, together with the sterilization of water and sewage, the construction and operation of purification plants, and chemical and bacteriological work connected therewith. He made surveys of rivers, lakes and water sheds, and traced the outbreaks of epidemics, as well as other work coming under the control of his department. Mr. Brewster will have charge of the health, water, sewage disposal and milk sections of the International Exposition of Municipal Equipment, and his broad experience will in all probability add much to the success of the Exposition.

THIN PLATE ORIFICES IN PIPE LINES

The selection of the type of meter to be employed in measuring the flow of water through a pipe line should be based upon the consideration of the difficulties of installation, permanency of operation, aacuracy of measurement, and the cost of installation and maintenance. Tests to determine the practicability of employing thin-plate orifices in pipe lines, and the conditions most favorable for their use as measuring devices, have been completed by the Engineering Experiment Station of the University of Illinois under the direction of R. F. Davis, Associate in Civil Engineering, and H. H. Jordan, Assistant Professor in General Engineering Drawing. The results of these tests are given in detail in Bulletin No. 109, entitled "The Orifice as a Means of Measuring Flow of Water Through a Pipe," free on request.

WATER WORKS SECTION

CONCRETE IN WATER WORKS CONSTRUCTION

By A. C. Irwin, Engineer, Structural Bureau, Portland Cement Association, 111 W. Washington St., Chicago, Ill.

Concrete has been used very extensively in various parts of water supply works such as dams, reservoirs, pipe lines, tanks, standpipes, filters, settling basins, power houses, etc. Obviously, a detailed discussion of all these is beyond the limits of a single paper and it will be necessary to confine the discussion to very general terms in order that we may touch upon each of these items, said Mr. Irwin in addressing the Iowa Section of the American Water Works Association.

Dams

Dams for impounding water are very generally of concrete. Concrete dams are usually cheaper than cut stone masonry dams and allow the utmost flexibility in meeting special local conditions. Earth dams, though sometimes low as to first cost when filling material may be excavated from side hills and dumped directly into the dam site, nevertheless have inherent weaknesses. Water flowing over the crest of an earth dam under flood conditions usually marks the failure of the dam. The activity of boring animals has also been responsible for earth dam failures since seepage or a small leak soon grows into a washout unless observed and corrected. Concrete cores in earth dams constitute a step in the right direction and sometimes make the earth dam justifiable, but cannot be said to satisfy all the requirements of permanent dam construction under all conditions. Such a dam may fail by overflow or by a slide of filling material.

Concrete dams may be divided into four general types: gravity dams, simple arch dams, multiple arch dams and buttress and slab dams.

Choice of the type best suited to any particular case must be the result of thorough investigation and consideration of all of the local conditions.

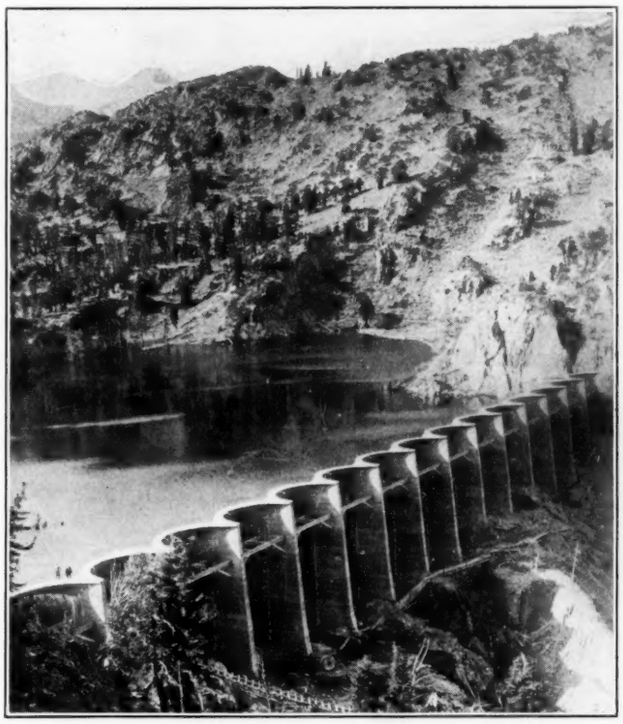
Gravity Dams

Some of the highest and most massive dams in the world are of the gravity type. However, for long and relatively high dams the selection of this type has usually been due to certain favorable local conditions as to supply of materials in large quantities or to a lack of sufficient investigation of other available types.

The gravity dam, of course, maintains its position and resists the thrust of the water by virtue of its weight. Foundation conditions for high and heavy gravity dams must be very favorable in order to assure success. Foundation conditions which because of seams will allow water to get under the dam, or which because of disintegration or erosion will undermine either the toe or heel of the dam, are unfavorable to such construction. Such cases require special treatment such as the construction of a deep cut-off wall under the base of the dam proper, filling the seams in the rock or the construction of aprons both above and below the dam. Upward pressure exerted by water under the base of the dam has been responsible for some bad failures. However, where foundation conditions are favorable the gravity type will usually be found economical for relatively long and low dams.

"Plums" in Dams

In this connection it may not be out of place to discuss briefly the use of "plums" or large stone in gravity dams. Difference of opinion relative to the advisability of using plums exists among engineers but a decision in regard to this point usually may be reached by considering the economies of the particular case. Where the section of the dam is great and if large stones are available at the dam site together with proper handling equipment, plums may be used with discretion. These, however, should be kept at least 1 ft. from the face or back of the dam and care should be observed in embedding them to see that no air pockets or hollow spaces exist, especially under the plums. In specifying the use of large stones in gravity dams it is safe to specify that the plums be limited to about 10 per cent. of the volume and that in proportioning the mixture the plums be considered as so much coarse aggregate.



GEM LAKE MULTIPLE ARCH DAM OF REINFORCED CONCRETE, 700 FT. LONG, 84 FT. HIGH.

Simple Arch Dams

Where a high dam is required to close a narrow open-

Printed as insert to Municipal and County Engineering, Chicago, Ill., November, 1919.

ing between solid rock side hills a simple arch dam will usually be found most economical. The design of such dams presents the simplest case of concrete arch design, since the load is uniform horizontally and exactly known at all points of the height. This enables the engineer to evolve an economical design.

It has been argued that the flow of water over the spillway or through the flood pipes of a dam sets up vibration which in the end proves disastrous. There is, however, little or no data obtained from experience to justify such apprehension. All types of concrete dams except the gravity type are, of course, reinforced, and the existence of countless reinforced concrete bridges and buildings which are constantly subjected to vibration is sufficient proof of the ability of this material to withstand whatever vibration is set up in dams. Nor is there any case on record of a well constructed plain concrete having failed because of vibration. However, if added insurance against such a possibility is desired it may be had by putting in reinforcing. Furthermore, where large temperature changes occur, reinforcing should be used. This constitutes added safety against likelihood of failure from whatever cause.

Multiple Arch Dams

The multiple arch type consists of a series of arches with inclined axes supported by buttresses spaced from 30 to 50 ft. apart. The buttresses take the thrust of the arches and are braced horizontally by struts in continuous lines. Some very high dams of the multiple arch type have been constructed and plans are now being prepared for one in California which will have a height of considerably over 100 ft.

This type, as well as the buttress and slab type, are especially adapted to locations where the foundation is rather seamy or unsuited to the gravity type because of the great expense involved in the preparation of the foundations. The footings of the buttress and lower end of the arches constitute the only points of contact between the foundation and the dam and these limit unfavorable foundation conditions to relatively small areas so that these conditions can be easily cared for.

It is apparent that if one of the arches of a multiple arch dam fails, successive failure of the remaining arches of the dam is liable to take place. This responsibility can be obviated by constructing every fourth or fifth buttress as a large pier to take the entire thrust of an arch on either side of it unassisted by the thrust of the adjoining span.

The multiple arch type has an advantage over the buttress and slab type in that it affords economy of construction when foundation conditions or great height require that the buttress or piers be placed at considerable distances apart. In other words, the additional cost of longer spans of the arch type are much less than where concrete slabs are used.

Construction of expansion joints is of course a rather difficult problem in multiple arch dams and it is very doubtful whether they need be constructed at all since expansion and contraction merely produce deflection of the arch rings.

Buttress and Slab Type

This type is especially adapted to long and low dams where the foundation conditions are more or less uncertain. It consists essentially of buttresses or piers the spacing of which need not be uniform, carrying slabs in an inclined position. The principle, of course, is the same as that of the well known counterfort retaining wall but the design is much simpler and more accurate since the thrust of the water is accurately known. In this type of dam expansion joints are easily constructed and variations in the distance between buttresses to take care of undesirable foundation conditions at particular points can easily be made. High buttresses should be braced together with horizontal struts or with diaphragms.

END AND SIDE VIEWS OF AMBURSEN TYPE REINFORCED CONCRETE DAM UNDER CONSTRUCTION, CITY WATER WORKS, OKLAHOMA CITY, OKLAHOMA.

Reservoirs

Reservoirs are usually a part of the water supply system. Impounding or natural reservoirs formed by damming the flow of a stream are common and the cost of them in so far as construction is concerned amounts usually to the cost of the dam.

In planning an impounding reservoir an investigation should always be made of the practicability of impounding more water than is necessary for the supply. The water over and above that required for supply purposes can be utilized in the development of power which will very often justify a much higher and longer dam and the construction of such additional facilities as are necessary to power development. The power so developed may be used for lighting or power purposes in the city served and is usually a large factor in encouraging the location of manufacturing enterprises providing sufficient power at a reasonable cost may be had.

In addition to large storage reservoirs the distribution of water for a large city will usually require the construction of secondary or distribution reservoirs. The location of distribution reservoirs is usually governed by

topographical conditions and are usually on a hill or high point of the surrounding country.

Prevention of seepage losses from reservoirs is an important item and especially so where the water is pumped into the reservoir. Seepage losses then constitute a constant loss which is directly chargeable to construction and which must be made up in water rates charged. Such losses should be prevented by making the sides and bottom of the reservoir as impervious as practicable. Paving with stones laid in mortar has been resorted to but it is obvious that concrete linings offer a very attractive and efficient means of preventing seepage losses. Concrete linings are admirably adapted to any type of reservoir whether of vertical or sloping sides. If the reservoir is entirely above ground it will of course be nothing more than a tank, but the usual construction provides that the top of the reservoir be even with or only slightly above the surface of the earth backing.

CONSTRUCTION VIEW OF 5,000,000 GAL. CONCRETE RESERVOIR FOR INSPIRATION CONSOLIDATED COPPER CO., INSPIRATION, ARIZONA.

For slope wall reservoirs the incline is usually from 1½ to 1 to 2 to 1. The thickness of concrete lining for slope wall reservoirs is from 4 to 8 ins., and is usually placed in slabs from 10 to 20 ft. square, depending on whether or not the slabs are reinforced. The slabs are usually laid with butt joints with their ends resting on a sill and the space between the ends of the slab filled with some elastic material to form an expansion joint.

Expansion joints between slabs have been very successfully made by calking with oakum and overlaying the joints with strips of burlap well painted with asphalt.

The Green River storage basin, Tacoma, Wash., was built with expansion joints ¼ in. wide at the bottom and ¾ in. wide at the top. Sills had tar paper laid on top of them before taking the slabs. The joints were filled with refined asphaltum specified to be pliable between freezing and a temperature of 200 degrees F. and not sticky at 100 degrees F. This joint has proven very satisfactory.

As a general proposition slope wall reservoirs as low as 300,000 gals. capacity may be built more economically than one having vertical walls.

Concrete Pressure Pipe

Some are skeptical in regard to the use of concrete for water pressures involving heads of 100 ft. or more. Concrete pressure pipe has been successfully used with pressures up to 80 lbs. per square inch and there is no doubt but that the pressure which may be handled by concrete pressure pipe is limited only by economy in design.

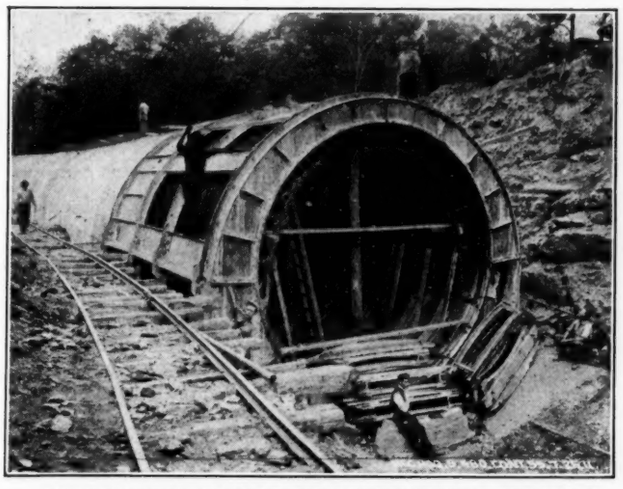
There are certain requirements which pressure pipe must fulfiill among which are the following: Ability to resist external and internal pressures; low co-efficient of friction; minimum leakage; low maintenance charges; permanency; provision for construction and expansion, and low cost consistent with the above requirements.

Concrete pressure pipe designed to withstand internal pressure will be found to be strong enough to withstand all ordinary external pressures to which it will be subjected. Reinforcing steel is of course placed in the shell of concrete pipe to assist in withstanding the bursting pressure and some designers use sufficient steel to take the entire bursting pressure. This steel is, of course, not in continuous sheets and therefore requires no complicated and extensive process of manufacture. For long lines of large pipe the pipe is constructed in place or at a convenient point near the general location of its use. Thus transportation expenses are low and the manufacture of the pipe can be given continuous inspection.

It is not our purpose to discuss the design of concrete pressure pipe but I wish to say that regardless of whether or not the strength of the concrete itself in tension is taken into consideration in design, it nevertheless does exist and contributes no small part of the actual strength of the pipe. Where it is not considered in the design this strength of the pipe affords an extra factor of safety.

Frictional Loss in Concrete Pipe

Correct methods of manufacture will produce concrete pipe with a low co-efficient of friction. An interesting test on an actual concrete pipe line would probably be most convincing in this respect. Such a test was conducted on the Sooke Lake water supply conduit for the city of Victoria, B. C. The pipe line is of 42 in. diameter, 27½ miles long and contains 50 per cent. of curves with radii varying from 90 to 150 ft. There are in the line 7 siphons having a maximum head of 94 ft. The tests were conducted by Wynne Meridith, San Francisco Manager of Sanderson & Porter, Consulting Engineers, and the co-efficient of friction (*n* of Kutter's formula) was found to be 0.01058 at the inlet end and 0.0117 at the outlet of the 27½ miles with the pipe running full



BLAW STEEL COLLAPSING FORM FOR 17 FT. REINFORCED CONCRETE EFFLUENT AQUEDUCT FROM KENSICO RESERVOIR, NEW YORK CITY WATER WORKS.

at the inlet and 6-7 full at the outlet. With 20 ins. of water at the inlet the water level at the outlet was 19½ ins.

Some years ago Marx, Wing & Haskins determined from gaugings on a 6 ft. steel riveted pipe values of *n* from .013 to .018.

The reinforced concrete pressure pipe line constructed as a part of the Gunpowder water supply for the city of Baltimore consists of 5,000 ft. of 108 in. diameter pipe and 3,000 ft. of 84 in. diameter pipe. This line carries 120,000,000 gals. daily and when tested under a head of 85 ft. the leakage in 24 hours of the entire line amounted to 13,000 U. S. gals., or less than two-hundrdths of one per cent.

Low maintenance on pipe lines must certainly result if the pipe is of such a material that leaks will not develop from corrosion, electrolysis, etc. Concrete, of course, is not subject to corrosion and since concrete pipe must be made sufficiently dense to prevent leakage it follows that the steel reinforcing in the shell of the pipe is perfectly protected so that corrosion cannot be expected. Of course concrete pipe lines as well as those of other materials are subject to such accidents as earth slides and cannot be expected to withstand extraordinary conditions under which no type of pipe line would remain intact. The maintenance, however, on a well constructed reinforced concrete pipe line may with confidence be expected to be low.

Permanence is merely a corollary to low maintenance charges. Rust, rot and decay are not defects of concrete pressure pipe and under ordinary conditions with pressures only for which the pipe was originally designed and constructed, concrete pressure pipe may be considered as permanent.

Expansion Joints

Contraction and expansion will occur in pipe of any material and suitable expansion joints must be provided in concrete pressure conduits if the leakage at joints is to be kept at a minimum. Such joints have been developed for use in precast reinforced concrete pipe and have been successful in practice. As the construction of pipe lines is usually done at temperatures higher than that of the water which will flow through the conduits it necessarily follows that contraction will occur. This will produce cracks at the joints through which leakage of considerable amount will occur if provision has not been made to care for the contraction.

An expansion joint that has been found to take care of expansion and contraction consists of a crimped copper band continuous throughout the circumference of the joint. As the pipe contracts the crimp opens and as the pipe expands the crimp closes. This joint is used in pipes of 36 ins. to 108 ins. in diameter.

It is well to reduce the number of joints by making the units as long as practicable, and each unit should be equipped with an expansion joint. Trench conditions, such as bracing, handling, etc., will usually determine the practicable length to be about 8 ft.

Manufacturing Pipe

Pipe are cast on end and the molds of sheet steel and cast iron must be erected on substantial bases or foundations of reinforced concrete, the surface of the foundations being truly level and finished so that when the cast iron base mold is set and the sheet steel casings are erected the casings will be truly vertical.

In the manufacture of most precast concrete pressure pipe, it is necessary to use 1 volume of Portland cement, 1½ volumes of sand and 2½ volumes of coarse aggregate and this means that 2½ barrels or 950 lbs. of cement is used per cubic yard of concrete. In the manufacture of precast pipe for the Winnipeg Aqueduct it was found necessary to use but one sack of cement to 3.8 cu. ft. of mixed aggregate, or approximately 2 barrels or 700 lbs. of cement per cu. yd. of concrete. (The Canadian barrel weighs 350 lbs. gross or 346 lbs. net.) This minimum quantity of cement was found practicable owing to the very excellent grading of the mixed aggregate which was supplied by the Greater Winnipeg Water District from their own pit at which was located a screening and remixing plant. The concrete is mixed to a quaking or jelly-like consistency, which will easily flow to place when slightly puddled.

The mortar for spigots is made of 1 part cement to 2 parts sand and is mixed to the same consistency as the concrete so as to obtain the same rate of setting as nearly as possible. As the spigot mortar settles more mortar is added until the settlement ceases, when the joint is finished.

Concrete pressure pipe may be successfully manufactured in cold weather with proper appliances for supplying heat and moisture. In fact, where high speed of manufacture is desired, steam curing should be resorted to and this may be carried on regardless of temperature conditions. For the manufacture of large sizes, appropriate handling equipment and appliances should be provided such as traveling derricks, locomotives, cranes and light industrial tracks, cars and locomotives.

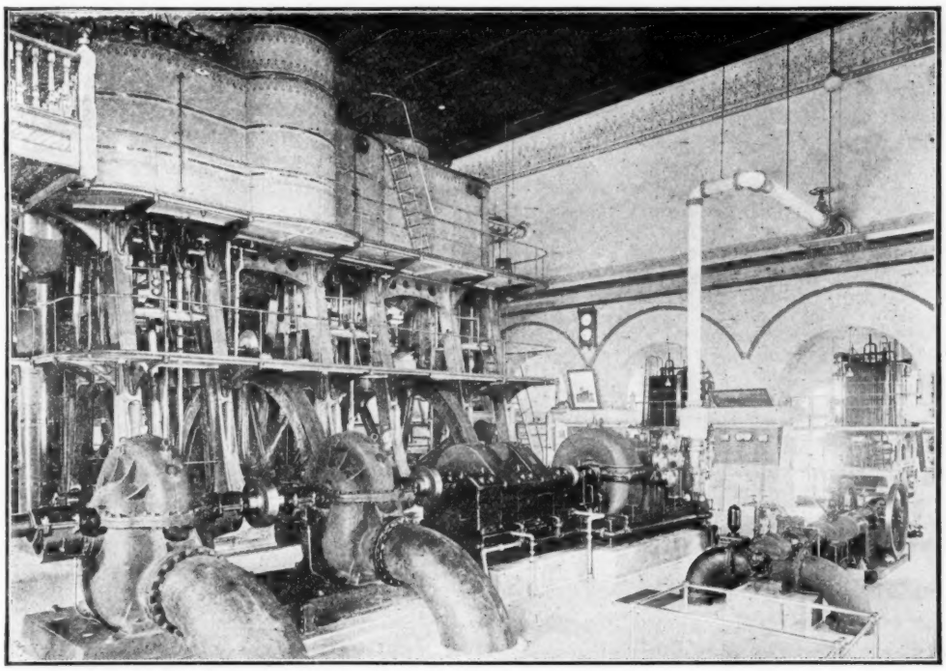
New Type Expansion Joint

All that has been said heretofore refers particularly to the copper expansion joint type of reinforced concrete pressure pipe. There has recently been developed a new type of expansion joint which is very efficient. This joint is proposed for reinforced concrete pressure pipe in diameters of 10 to 48 ins. and in lengths of 12 ft., each section of pipe being provided with cast iron spigot ring at one end and a cast iron bell ring at the other, the rings being cast into the concrete.

The faces of the rings bear upon a lead gasket and are accurately machined providing a very true circular surface. The spigot ring is provided with a seat for the gasket, the object being to provide a greater thickness of gasket at the seat and to prevent the gasket being withdrawn when the pipe contracts or is deflected. The lead gasket consists of a thin lead pipe filled with fibre and is compressed into the space between bell and spigot when each succeeding length of pipe is shoved home. A light rope of cotton or jute is placed and a weak joint filler of cement mortar is applied filling the calking space, which is provided in the event it should be necessary to calk the lead gasket joint. The joint has remained tight under test at 110 lbs. pressure per square inch.

Tanks and Standpipes

Familiarity with the success that has been attained in the use of concrete pressure pipe prepares us at once to accept the reinforced concrete standpipe or water tank. Here again we have simplicity in design because of ac-



The OLD and the NEW in Water Works Pumps

is well illustrated in a corner of the Pump Room shown here of a large municipality.

The imposing and ponderous triple-expansion pumping engine has a capacity of 20,000,000 gals. per day against 250 ft. head. It is even larger than appears in the photograph, for there is about as much below the floor as above.

The De Laval steam-turbine-driven centrifugal pump in front of the reciprocating unit has a capacity of 30,000,000 gals. per day against 250 ft. head.

The saving in space and cost of foundations is obvious, and had the building been put up for centrifugal pumps only, it need not have been so high nor so heavy in construction, and only light crane equipment would have been required.

All working parts of the turbines, gears and pumps are accessible by removing the comparatively small and light casing covers. Valves and packings are eliminated, and the lubrication system is simple and economical, the oil from all bearings being supplied from one oil pump, and being used over and over.

The De Laval geared-turbine-driven circulating pump in the foreground has a capacity of 3000 gals. per minute and exhausts into the same condenser as the main unit.

De Laval turbine-driven centrifugal pumps are most economical for water works service when all costs, including interest and depreciation on machinery, foundations and buildings, are included.

DE LAVAL STEAM TURBINE CO.

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TRENTON, N. J.

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curate knowledge of the pressures to be withstood. Obviously, if concrete pipe can be constructed uphill and down, in and out, to withstand over 100 ft. head of water pressure, there should be no difficulty in building a standpipe of like height and many examples are in existence of concrete standpipe of much greater height than this. The Fulton standpipe at Fulton, N. Y., is 100 ft. high to overflow and is 40 ft. in diameter.

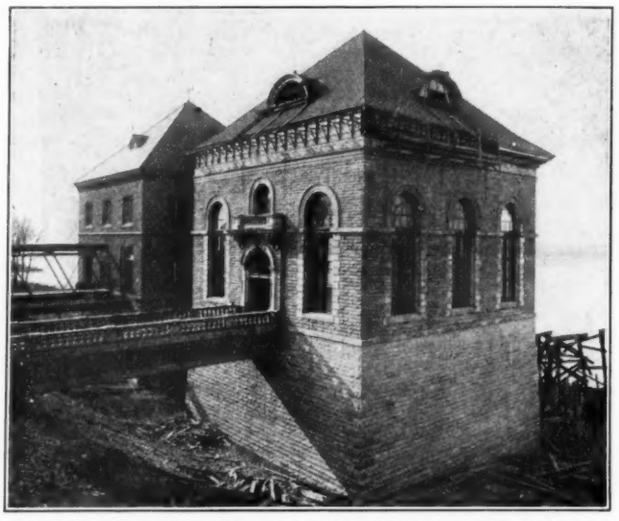
Towers

The supporting tower of elevated tanks may be either of concrete frame work or of the cylindrical type. The latter has a number of advantages. The same forms may be used to construct the supporting tower as are used in the construction of the tank support. These forms are usually what are known as moving or sliding forms, that is, they move gradually upward as the concrete is being placed, thus giving a continuous monolithic concrete shell without any construction joints whatever. In addition to this particular advantage in construction the cylindrical tower furnishes a housing for the riser pipe which protects it from low temperatures and may even be utilized for storage or office purposes.

In the design of concrete standpipes and in fact in the design of such structures of any material, the critical point is usually found in the junction of the shell with the base. The Fulton tank referred to is an example of a successful method that has been used to take care of the expansion

REINFORCED CONCRETE WATER TANK OF BUCKEYE COTTON OIL MILLS CO., ATLANTA, GA.

and contraction at the bottom of a standpipe shell due to variations in water level and temperature. The central portion of the foundation for this tank was constructed higher than the point of contact between the bottom of the shell and the foundation. Thus, space was formed between the inside of the shell and the central raised portion of the foundation. This space was filled with an asphaltic material. The shell of the standpipe proper was not connected to the foundation but rested on a slip joint which allowed movement at the base of the shell to provide for change in the diameter of the standpipe due to variations in pressure. The top of the concrete foundation on which the shell rests was first covered with



OLD AND NEW PUMPING STATIONS OF THE LOUISVILLE, KENTUCKY, WATER WORKS.

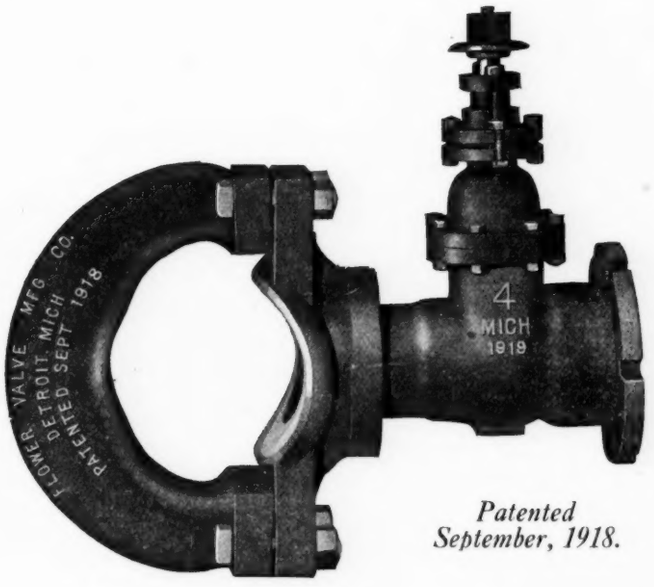
graphite paste and sheet copper laid immediately on top. The walls of the standpipe thus rest upon the sheet copper plate which is free to move on the graphite.

This standpipe was constructed with sliding forms and was completed from foundation to overflow in 52 working days. It has been in constant use since 1913 and has proven entirely satisfactory.

Pump Houses

The use of concrete in the construction of buildings of a general nature is too well known to need any particular comment. A pumping station, of course, has some special features required by the fact that it houses machinery and boilers. A pump house therefore best adapted to its purpose is one which will be free from vibration, furnish adequate light and afford security against fire. These requirements are all most ideally met by concrete.

An interesting example of recent pump house construction is that recently completed for the city of Louisville, Ky. This pumping station is located on the bank of the Ohio river just east of the city's old pumping station. As the structure had to rest on sand and gravel and as it was necessary to build the foundation so as not to affect the adjacent buildings, the open well, caisson method was used. Outside dimensions of the caissons are 90 ft. square by 33 ft. deep, with a bay on the river side 61 by 22 ft. and 33 ft. deep. Interior cutting edges were 5 ft. 2¼ ins. above outside cutting edges, thus allowing room for a working chamber in case obstructions were encountered, compelling conversion of the caisson from the open well to pneumatic type. However, this contingency did not arise and the caisson was sunk to its final resting place without mishap. After filling the dredging wells, the foundation became a solid block of concrete, 90 ft. square by 28 ft. thick under the main house and 51 by 22 ft. by 16 ft. thick under the bay. On this foundation the sub-



Patented September, 1918.

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The exclusive advantages of this sleeve are typical of the better design of all Flower products.

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(12)

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structure extending to the main floor level was built. This is 83 ft. square at the bottom and tapers to 75 ft. square at the main floor level, which is 7 ft. 6 ins. above high water. The inside of this part of the structure is cylindrical, 67 ft. in diameter, and forms the pump pit. Cylindrical pump pit walls were designed to resist external water pressure and the construction has resulted in an absolutely dry pump well.

The superstructure is 48 ft. high to the under side of the roof. The walls between the large windows forms a series of piers supporting in addition to the roof loads, runway girders for a 30-ton crane.

No concrete shows on the face of the superstructure but back of the 6 and 9-in. ashlar surface is a concrete wall 30 ins. thick, which in reality amounts to piers between the high windows and, as previously noted, supports the runway girders for the 30-ton crane. Stone facing was used in order to make the new station as much like the old one as possible in external appearance.

Construction is being done by the Fruin-Colnon Contracting Co. of St. Louis, Mo., and the Missouri Valley Bridge & Iron Co., Leavenworth, Kans., after designs by J. B. Wilson, Chief Engineer, Louisville Water Co.

Fuel Oil Storage Tanks

At the present time there is a very marked tendency to use fuel oil in the place of coal for the generation of power. There are certainly many advantages to be derived from the use of this fuel. It does away with a considerable amount of the handling expense, leaves no ashes and cinders to be disposed of, and produces but relatively little smoke. Firing with fuel oil is a simple matter and effects economy in labor.

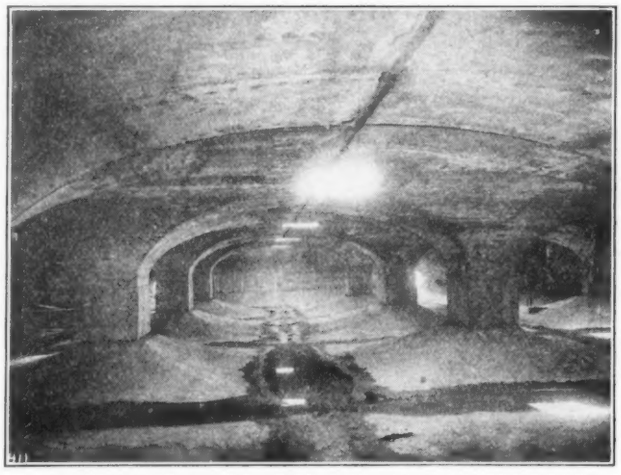
In order that fuel may always be available and that the purchasers of it may have the opportunity to take advantage of market conditions, storage capacity should be provided. The storage of fuel oil has been and is still subject to considerable discussion, especially in regard to the effect that the presence near buildings of such combustible material has on the fire hazard. It is my understanding that there is an almost universal practice to add a very heavy penalty because of the presence of fuel oil in open tanks above ground. This penalty, however, is not added when the oil is stored in concrete tanks below ground. There are further arguments for the underground storage tank. Such tanks do not occupy space near the power plant which is usually required for other purposes. They are entirely out of sight as well as protected against the likelihood of fire from lightning or from other origin.

The design and construction of concrete oil tanks is little or not at all different from concrete water tanks. In fact, it is usual to design them for ordinary hydrostatic pressures, and experience shows that when well constructed entire confidence may be placed in their ability to hold the oil without leakage. Naturally, where the surface of the tank is level with the ground surface and will have to carry loads, the cover must be designed accordingly, and usually requires the use of columns which rest upon the tank bottom.

Water Filters

Filters, whether of the slow sand or mechanical type, have quite generally employed concrete for structures. The slow sand type requires large areas of filter beds, constant attention and a very considerable first cost. I believe also that it is safe to say that a mechanical system of filtration is the one usually adopted in modern water works construction. A very complete and extensive plant of this kind was installed some years ago for the city of Baltimore at Lake Montebello.

Special features of the Montebello filters include handling of wash water at settling reservoirs, head house



INTERIOR VIEW OF LAKE MONTEBELLO CLEAR WATER RESERVOIR CITY WATER FILTRATION PLANT, BALTIMORE, MD.

arrangement, pumping station and covered reservoirs. Complete accounts of this notable water supply development have been previously published in the technical press, and we shall therefore confine ourselves to a very general description of those portions in which concrete was used.

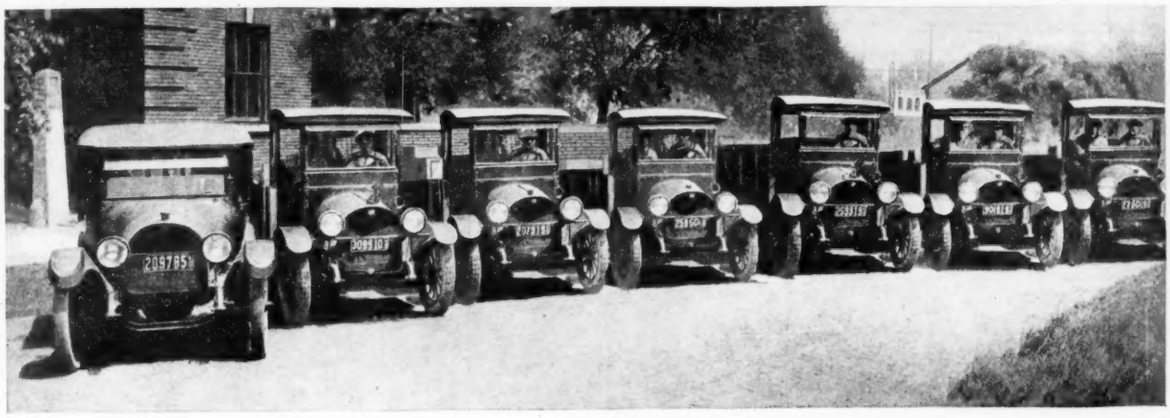
About 50,000 cu. yds. of concrete were used in the construction of the filtration plant, and most of this concrete withstands water pressure or heavy loads. The groined arches of the filtered water reservoir are of 1:2½:5 mixture, but other structural parts are of a 1:2:4 mixture. No waterproofing compounds were used in these structures, as good workmanship and materials were relied upon for securing waterproof work. Steel forms were used in the construction of the groined arches and walls, but were not found to be entirely satisfactory on account of difficulty in erecting and removing them. It is worth while to note in passing that at the present time steel forms are available for construction of this sort, which add a great deal to the ease with which it can be accomplished, and I feel quite sure that in the design of such a filtered water reservoir at the present time a flat slab construction would be used in place of the groined arches, and that standard steel forms for columns and slabs would be used.

The filter tanks of the Montebello filters are 32 to 35 ft. outside dimensions and are supported on the reinforced arches forming the roof of the filtered water reservoir.

The head house of the Montebello filters is also of concrete, and a feature of it is the elevated tower 4 ft. square and 80 ft. high containing the chemical storage bins. This tower has 15 bins which will hold about two carloads of chemicals each.

The pumping station is circular in plan, 84 ft. in diameter, with its walls concentric with the intake shaft and

REO



TELEPHONE 4000

CITY OF EVANSTON
DEPARTMENT OF STREETS
EVANSTON, ILLINOIS

ROBERT M. BROWN
COMMISSIONER

July 15th, 1919.

Our Street Department has in service five two ton, Model "J" Reo trucks and one Model "S" Reo Roadster.

The two trucks first purchased, equipped with Lee automatic side dump three yard steel bodies entered service April 2'd, 1918. One of these was wrecked August 8th, 1918 and replaced August 24th, 1918.

On July 26th, 1918, our Special Garbage Truck entered service, equipped with a wooden body designed to carry 120 garbage cans of one cubic foot each.

On March 26th and April 9th, 1919 two more trucks entered service. These are equipped with three yard Woods' hydraulic hoist rear dump steel bodies.

The roadster entered service May 14th. 1918.

These trucks have hauled crushed stone, sand, cinders, coal, ashes, rubbish and garbage continuously over paved and unpaved streets and alleys in all kinds of weather.

The consumption of gas and oil has been low, the repairs small and I consider the results remarkably good.

I am told the Model "F" truck, in service from March 26th, 1919, equipped with hand hoist rear dump steel body and operated by the Sewer Department is giving equally good results.

Robert M. Brown

Commissioner of Streets

"THE GOLD STANDARD OF VALUES"

Reo Motor Car Company
Lansing, Michigan

16 ft. in diameter. The intake shaft is located with its center over the axis of a 12-ft. tunnel that brings the city water supply from Lock Raven. The bottom of this tunnel is 49 ft. below the floor of the pump pit or 72 ft. below the surrounding ground level.

INSTALLATION AND OPERATION OF AIR LIFT PUMPING PLANTS

By Charles J. Deem, Hydro-Pneumatic Engineer, Harris Air Pump Co., 1635 Lytton Bldg., Chicago, Ill.

When air lift pumping first entered the commercial field there were a great many conditions surrounding its operation that were unknown even to the manufacturers of the lifts.

It has been charged by many, and more especially by engineers, that the manufacturers of air lift pumps wish to surround their products with mystery. I can truly say that this is not the case. The manufacturers of air lift pumps, like any other trades people, want to sell all of their products they can, and willingly give all the information regarding its operation that will make it more popular in the deep well pumping field. However, they are limited in this service from the fact that no *master formula* has as yet been devised, whereby infallible rules may be laid down for the proper designing and installing of any and all installations, without any regard for the conditions that exist in the wells, said Mr. Deem, in addressing the Iowa Section of the American Water Works Association recently.

Some fifteen years of experience have taught me that in many, many instances, wells are just as individual in their actions as are persons. Therefore, a properly designed air lift installation, operating satisfactorily in one well, might give entirely different results when installed in another well which to an inexperienced operator might seem to be identical with the first.

While experience is not absolutely essential to the pumping of water from deep wells by the means of compressed air, yet, I know of no engineering field where experience counts for more or is more essential than in air lift pumping.

Some of our best engineers have branded air lift pumping as a system sadly lacking in economy, but in such cases their judgment has been based upon results obtained from improper methods of piping in connection with inefficient air compressors. Many have also become convinced that there is no special merit in the patented air lift pump, and believe that home made devices will answer the purpose just as well. However, in all my years of experience, I have never yet seen one of these home made lifts compared with which a patented pump would not give excellent returns on the small amount of money invested.

How the Lift Operates

Contrary to a popular belief, the compressed air discharged through an air lift pump does not blow the column of water upward after the first discharge. When the static head is lifted from the working head of the well by the first inrush of air, the water is forced out of the pipe in a solid column. After that, the compressed air passing through the pump reduces the specific gravity of the water in the discharge line of the pump. This consequently moves upward by the expansion of the air bubbles, aided by the greater weight of the solid column of water, surrounding the discharge line. In an economically designed air pump, it is imperative that the formation of large bubbles of air be avoided, for these have a tendency to rush upward without lifting the proper amount of water for the stored energy that they contain. Therefore, the pump should divide the air into small streams or jets, creating as many small bubbles as possible in order to give the best economy. The slip of these bubbles constitutes the chief loss in the energy of the air lift. It is figured that this varies as the square root of the volume of the bubbles. Therefore, the smaller the bubbles, the more efficient the air lift.

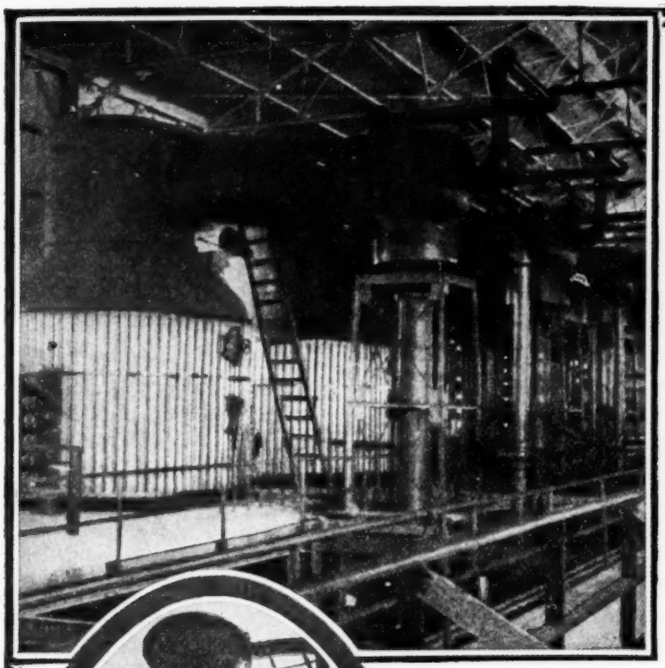
Of course, one of the foremost things to be considered in the installing of a pumping plant, is its efficiency. I presume there is no one word in the English language that is used more in manufacturing and engineering circles than the word efficiency. It is a good strong word, but may be figured from so many different bases of calculation that all conditions in connection with the apparatus must be thoroughly understood before the percentage of efficiency that is claimed for it, can be valued. The only true way I know to figure the efficiency of a pumping plant is to add up at the end of the year the column in the ledger headed operating costs, and to calculate the results from its total. In this column we will also find, if we note down the items, such as repairs, break-downs, and their attendant losses, and read between the lines, the worry that was caused thereby. Then we can determine just how efficiently the system has operated.

Reliability of Air Lifts

In traveling over the country, I find that water works superintendents and manufacturers are more and more demanding workable commercial efficiency from their pumping machinery. They realize that by installing some very closely adjusted high speed apparatus in their wells they may be able, during its short life, to pump water very cheaply per 1,000 gals. But in about nine cases out of every ten, such a pump is sure to cause trouble sooner or later, more often sooner. The small amount saved per 1,000 gals. pumped, during the course of the pump's successful operation, is far more than offset by repairs, shut downs and pulling of wells.

To give you some idea of the faith that the underwriters of the country have in the reliability of the air life system, I will tell you Mr. Judd's experience with them in discarding deep well pumps and installing air lift systems in the city wells in Mason City, Ia. The Board of Underwriters in Chicago granted him 30 points on the key rate of insurance for the fire protection the increased yield of the well would afford the city, and they gave him 130 points because of the reliability of an air lift pumping system. This is something that should be weighed very carefully, for if there is any institution that figures from exact statistics, it is the Underwriters. They don't guess, they know.

No one has yet been able to figure a master formula for the installation of the air lift. However, the manufacturers of air lift pumps have, at a great expense,



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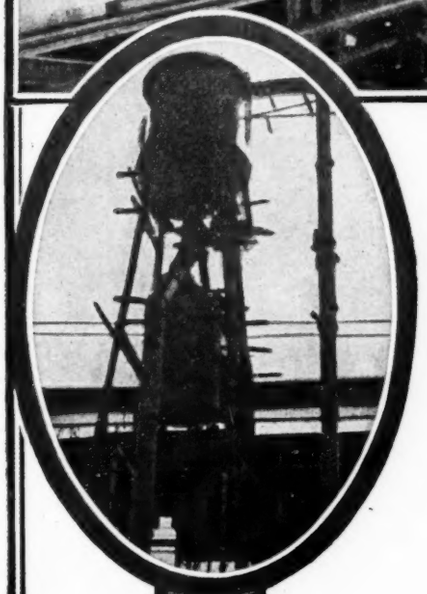
(Point Pleasant)
Sugar Mills

The engineers and builders of this great Cuban sugar factory used Cast Iron Pipe wherever possible—and in some places where it had hitherto been thought impossible.

Note the condenser tower tank with two lines of 24-inch bell and spigot and flanged pipe for handling sea water.

The entire water supply, both salt and fresh, is handled through Cast Iron Pipe, in sizes from 6-inch to 24-inch diameter, which, with the Cast Iron vacuum pans, condensers and leg pipes in the factory, insures freedom from frequent and expensive replacements.



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gathered data from laboratory tests and field experience that enable them to construct formulas which cannot be universally applied to all conditions, yet they can define and introduce certain rules which enable them to calculate the requirements for an installation when the exact data are known.

Perfecting Installation Under Service

When exact data are lacking, conditions are usually *assumed* and a lift installed. Then from results obtained, the engineer can, by basing his judgment on experience, proceed to pipe up the well so as to get economical results. To give an illustration of this: some years ago I installed an air lift in a flowing well on a ranch in southwest Texas. The well was eight inches in diameter, about 600 ft. deep and flowed about 20 gals. a minute. The owner of the ranch had only a small compressor, its maximum capacity being 30 cu. ft. of compressed air per minute. A 6-in. pump was installed, 2 ft. in the well, and this 30 ft. of air delivered to it. The head of the well dropped 20 ft. from the surface and the well yielded 530 gals. per minute, accurately measured over a knife-edged weir. Of course, this was phenomenal. Never before or since have I seen such a small volume of air deliver so much water from a deep well.

Recently at Fort Dodge, Ia., we installed a 6-in. pump in a flowing well, located in an island in the Des Moines river. The well was 8 ins. in diameter, 500 ft. deep and flowed 21 gals. per minute. The same size pump was located 200 ft. from the surface and we delivered to it 200 cu. ft. of air. The working head of the well dropped 150 ft. from the surface and yielded 80 gals. per minute. As one can readily see, this proved to be a very uneconomical installation. Yet to all outward appearances, the conditions in the second well were the same as those in the first, and the results were not even comparable. It is in this second well that experience would have been necessary to have piped it up properly had the city decided to use it. However, they had plenty of other water available, so the well was abandoned. But an air lift could have been installed in it that, figuring from the current input at the motor of the compressor to the water discharged in the reservoir, would have shown 30 per cent. efficiency. This could have been obtained by installing a 3 in. air lift and taking 50 per cent. submergence, or, in other words, by placing the lift as far below the working head of the well as we were going to lift the water. This would have yielded 1 gal. of water for 0.63 cu. ft. of air at 67 lbs. pressure. Of course, the starting pressure in this well would have been greater than that of the other wells of the system, yet this could have been offset by the use of an auxiliary air line to lift the head of the well.

Had the original installation in this well been let stand, any one wishing to speak disparagingly of air lift pumping could have, in all honesty, cited it as an expensive mode of pumping water. On the other hand, some manufacturers, wishing to extol the virtues of their air pumps, might honestly print a glowing advertisement of the results obtained in the well first described. They would be equally misleading. The first is a result from what might be termed a freak well, while the installation of a 6 in. pump in the second well would be improper for the best results obtainable by the air lift system. I only cite these two wells to illustrate my point that each well forms an individual problem, and that the same installation in all wells would fail to pump them properly.

Aeration

One reason why the air lift pump proves valuable, where the water contains much iron and sulphur, is that when a well is pumped by air the water undergoes aeration. The air and water are mixed under pressure and this tends to throw off the sulphur gas and precipitates a great deal of the iron; one of the principles on which the iron breaker works is aeration.

Some Advantages of Air Pumping

Many wells pump a great deal of sand and as the air lift has no moving parts in the well, grit has no effect upon it. Any number of wells may be pumped from a central plant and there is no limit to the quantity of water that can be handled. With a properly designed system the extra cost of pumping wells located a mile from the power plant is not material.

It has been stated that an air lift system requires little or no attention outside of keeping the compressor in proper running order. While this is practically true and cited as one of its advantages, yet sometimes it proves to be a disadvantage, because an installation will continue yielding water for years without giving any trouble. Yet there are times when the system becomes unbalanced, the working head of the wells recede, which changes the percentage of submergence, thereby reducing the yield of the well and increasing the amount of air required. So you can see that if the wells were checked up once or twice a year, and changes made to meet the new conditions, a great deal might be saved in operating cost.

Keeping the System Balanced

Sometimes very little things cause a great loss in economy. Not long ago I was called to a plant where a battery of five wells was being pumped from one compressor. The compressor at its maximum speed was barely large enough to pump the amount of water required. The operator told me that when the plant was first installed it gave excellent results, but there had been a decided falling off in the yield of the wells. The system was well designed and should have given good results. Upon investigation, I found that two of the wells were much weaker than the other three, and that they operated at about 15 lbs. less pressure than the other wells. When the engineer had balanced up the system, he had set the regulating valve at the well head of these two weaker wells so as to admit only enough air to pump the water that they would economically yield, and, of course, had left the valves wider open on the strong well. When starting the system pumping, the operator discovered that many times these two weak wells did not come in. Their static head being the same as the stronger wells, and being supplied with much less air they did not start so easily. In order to overcome this he had thoughtlessly taken a wrench and opened the valves of these two weaker wells. Of course, any force follows the line of least resistance, and the larger part of the volume of air, made by the compressor, rushed into the weaker wells from which it could not lift the same amount of water as it could have done from the stronger wells. Therefore, this system was out of balance and giving poor results,

through no fault of theAir Lift or the man who installed it. When air lift systems are counted excessively costly to operate, I think it may safely be concluded that there is good cause for this, and that the chances are the troubles may be easily removed.

Determining Size of Pump

A great many mistakes are made when installing air lifts, especially by novices in the business, in choosing the size of the pump to be used to deliver economically a certain volume of water. In order to make that as plain as possible, I will give a concrete example:

If we wanted to lift 150 gals. per minute from a well with a working head 80-ft. below the surface, the most economical pump to be installed would be at 3½-in. lift at 65 per cent. submergence. Under these conditions, this pump should yield 1-gal. of water for every 0.3-cu. ft. of air at 67-lbs. pressure. As one can easily figure, the pump would be located 229-ft. from the surface. Now suppose instead of being able to get 65 per cent. submergence, we can get only 40 per cent. submergence. In order to deliver 150 gals. per minute under these conditions, a 4½-in. pump should be used and one could expect 1-gal. of water for every 0.59 cu. ft. of air at 25-lbs. pressure.

By a little figuring the engineer can ascertain that it required 1.1 more horse power to raise the water in the second instance than it did in the first. And I gave it, hoping to be able to show that even though conditions be vastly different in various wells, a properly designed air lift can be made to yield good results. But, of course, there are places and conditions under which some other type of pump should be used.

As can be noted from this example, as the submergence decreases, the size of the discharge line should increase. But this is only a general rule and the conditions in the well to be pumped wholly govern the change to be made.

Variable Diameter Discharge Line.

Of late years some firms have been advocating a variable discharge line. I mean by that some firms wish to start with a smaller pipe and expand toward the point of discharge, the theory being that by allowing the compressed air more space in which to expand, it will lend more of its energy toward lifting water. On the other hand, some firms advocate turning this type of installation upside down, as it were. That is, they reduce the line toward the point of discharge, the theory being the same as the reason for choking the muzzle of a gun in order to keep all the gases behind the shot until it leaves the barrel. Of the two systems, so far as observation goes, the latter is to be preferred. I have seen it produce excellent results under some conditions. That is, it gets more water with greater economy than it would be possible to get from a uniform discharge line, made of standard pipe sizes.

I suspect the friends of the expanded discharge line system will challenge this statement and point to some installations they claim are a great success. I have seen one or two of these but they have invariably been installed in excellent wells that yielded large quantities of water

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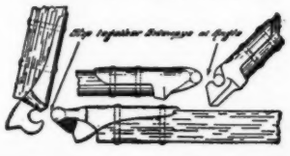

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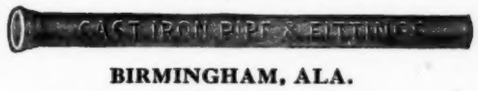

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very economically, not because of the system of expanding the discharge line, but in spite of it. However, improvements are being made in the system of piping and each year shows more practical results. My firm has recently placed on the market a new pump, which under very exacting conditions has shown 15 per cent. more efficiency than is possible to obtain with the design it supercedes.

The Booster Pump

Another improvement in the air lift system that I wish to mention briefly is known as the booster pump. This pump, or tank, is located on the well top and automatically separates the air and water as it is discharged from the well, and retains just enough pressure from the separated air to force the water to the point of discharge. This is indeed a great improvement, when the water must be transferred long horizontal distances toward the point of discharge. This point may be at the surface or to an elevation. Hitherto, when horizontal distances had to be considered, unless the water was delivered to an elevated tank and allowed to flow by gravity, the air would get ahead of the water in the discharge line thereby materially reducing the efficiency of the system. However, the booster very efficiently overcomes this condition.

I realize that I have given no tangible data on the air lift, but as I have endeavored to explain that from the varying conditions that exist in all wells any statements regarding the air lift system as a whole, must be of a general nature. Some manufacturers have, at no little trouble and expense, conducted exhaustive, systematic tests in natural wells or in artificial wells constructed for the purpose of maintaining any desired submergence by feeding water into their tops. The data thus gained are authentic for the conditions under which they were gathered. However, in the field, nature does not make a habit of supplying her wells with water by pouring it in at the top. So you see we revert back to the same point from which we started. That is, each well presents a separate problem.

Another thing that has materially aided in the efficiency of the air lift system is the perfecting of air compressors by the various manufacturers. The standard compressors now offered on the market in nearly every instance operate on from one-third to one-fourth the horse power that was required by the compressors built some 10 or 12 years ago. Not only is the economy of these machines much greater but also the mechanical parts have been greatly simplified, thus making the air compressor one of the most economical machines now on the market.

I have followed the success of the air lift pumping system for 15 years and have been personally connected with it all of this time in practical field work and have become a more ardent advocate of it each day.

NECESSARY STEPS IN REVISION OF WATER RATES

By John N. Chester, of Chester & Fleming, Engineers, Union Bank Bldg., Pittsburgh, Pa.

Assuming that conditions beyond the control of the water company have created the necessity for a larger gross income, which can only be derived by revising upward the rates charged the water consumers and patrons, the present article is an answer to the question: "What are the necessary logical steps to be taken?" The 10 steps follow; with special reference to Pennsylvania conditions:

1. Get together with the community if you can and in your negotiations do not forget the other fellow.

In other words, in every change you make or condition you impose, put yourself in the consumer's place and try to realize its fairness from that angle.

2. Be prepared to begin your activities with clean hands.

That is, you should for the past five years, at least, have had available at all times enough water and facilities for and have been rendering continuous service; the supply as to purity should have been above question; and no reasonable consumer should be able to charge you with discourteous dealings.

3. A value—tentative, actual, or otherwise, as a basis for rate making should be available.

This value can scarcely be the face value of your stock and bonds; it can seldom be what you paid for the plant, but it is, according to the Public Service Act, akin to the book or historical cost of plant and business, or the cost of reproducing your plant and business, less depreciation. The above may be obtained in one of three ways: an audit, an appraisement, or a reconnaissance by some one sufficiently expert to fix, after a casual survey, a tentative value from which an approximate fair return may be computed—subject, of course, to its being substantiated in a hearing or checked by experts mutually chosen by both parties.

4. Operating expenses which include repairs and maintenance.

These should be tabulated by years for the last five years and your operating expenses as of today should be set out, and from the two a forecast of next year should be made by applying present day prices to average or estimated necessary quantities of material and wages.

5. A reasonable amount should be allowed for administration, or salaries of executive officers and executive office expense.

We too often find companies failing to carry on their payroll that very necessary officer—a superintendent, preferring apparently to swell somebody's head by giving the individual performing the function of this office the title of secretary or treasurer, and some times president or vice president, which titles belong only to executive officers and not operating officers, and if an individual performs the services of one of the administrative officers as well, his pay should be divided between operating and administrative expenses, and administrative officers, be their duties ever so small, and this includes directors, should be compensated for service rendered, and a part of this service, it must not be forgotten, is responsibility assumed.

6. A fair amount should be set aside for depreciation.

This may be obtained from observation, or it may be computed scientifically, and in either case—functional depreciation must not be overlooked.

7. Over and above operating expenses, depreciation,

and administration, each property is entitled to a fair return on its investment.

A fair return has, by different decisions of our commission, been fixed at 7 to 8%. No greater than the latter should be hoped for, and no less than the former accepted without invoking the aid of the court of last resort. This last statement is not intended to imply that a hearing before the Public Service Commission is a necessity if rates are to be raised or revised; on the contrary, nearly as many controversies as have been heard by the Commission have been adjusted between the municipality served and the water company to the satisfaction of both and with very much less expense; but an adjustment having been reached amicably or by decision of the commission or courts, the next problem that confronts us is:

8. Distribution of burden or casting of an equitable rate schedule that will assure you operating expenses, administration, depreciation and a fair return.

You will need first to ascertain the amount chargeable for public fire protection, after which an equitable charge should be fixed for private fire protection, and the total to be obtained from these two subtracted from the gross is the amount yet to be equitably distributed to the consumers. Many of you yet have in force the antiquated flat rate, which should at this time be eliminated or arrangements made to eliminate it as fast as possible and to substitute therefor the only fair method of vending water, to-wit: meter service, and if you have yet to begin the application of meters, let me advise that you apply them first to your industrials, next to your commercials, and then by classes to your domestic consumers, setting the first meters on the users of water for power—such as operating washing machines, sewing machines, etc.; next, to the owners of sprinklers of large lawns, the next class might be all of those having water closets or bath rooms; and lastly, the one spigot users, and especially those with no sewer connections; but this is digressing, for the problem is to work out a meter schedule that will equitably distribute that portion of the burden chargeable to domestic, commercial and industrial consumers; and accompanying the rates, which, to be legal, must be filed with the Public Service Commission, there should be a set of

9. Rules,

The first of which are generally those relating to application for water, methods of making tap, providing meter, etc., which must necessarily differ with localities, franchises, and previous customs, it being best in the writer's opinion not to disturb usages long in vogue that seem fair and equitable, although they may not be as modern as similar practice elsewhere; but in addition to all of the above sufficient clear, concise, and practical rules should be added to guide both operator and consumer in the future conduct of the business and in a way that will eliminate controversy and still promote an equitable conduct of affairs.

10. This brings us to the last act of the drama, which is the enforcement of the new rules and rates, which in many cases requires courage, and in all cases, fortitude, which should be accompanied by the utmost courtesy extended in the way of investigation of complaints, willingness at all times to interpret clearly things which the consumer fails to see or understand, but never lacking firmness, which can only exist where the individual is saturated with belief in what he undertakes to enforce.

The foregoing paper by Mr. Chester was recently presented before the Pennsylvania Water Works Association at Atlantic City, N. J.

EFFECT OF WAR-TIME PRICES ON WATER WORKS VALUATION

By E. W. Clausen, City Attorney, Atchison, Kansas.

The first economic question in water works valuation at the present time is the effect of war-time prices and in this connection it is interesting to note that there is a decided difference between value and price, said Mr. Clausen in addressing the League of Kansas Municipalities.

Things have a market price at present which cannot be said to represent the true value, and the Courts have decided that this is the fact. Probably the most recent expression on this subject is the following statement of the Illinois Public Utilities Commission:

"As joint petition of the Southern Illinois Light & Power Company and the Centralia Gas & Electric Company for authority to purchase and sell electric and gas property of the Centralia company has been dismissed by the Illinois Public Utilities Commission. On the question

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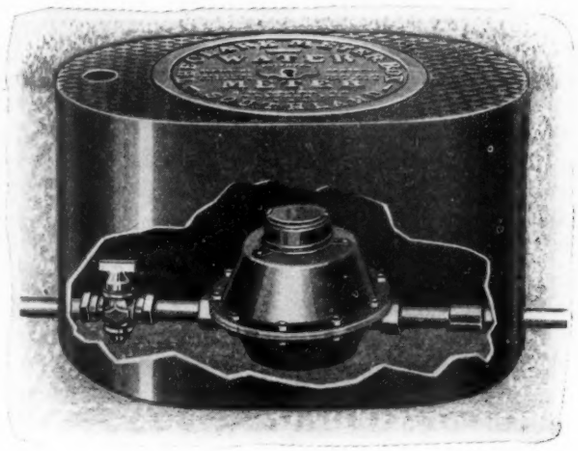
of war-time prices, the decision says: 'The Commission cannot subscribe to a valuation which is based upon war-time prices in a case where substantially no investment has been made under war-time conditions. To do so would result in burdening a public already carrying a heavy load of war-time prices with increased costs of service received from plant and equipment which has experienced no added usefulness because of the war-time situation. Such a burden so placed could benefit only the interests selling the property, to the permanent disadvantage of the public which receives the service and the utility which would assume the responsibility of operating it upon a financially sound basis. We do not wish to be understood as condemning investment wisely and prudently made in the necessary development of utility property during war times. In many cases extensions and betterments have been made in the interests of the public good under these unusual and trying conditions. Capital so invested is entitled to consideration, but such does not appear to be the case to any marked extent in the present case'."

Of course, there is a war-time appreciation which should be allowed and so many of the commissions are now approving the principle of determining the cost of reproduction, accepting a ten year average price under present war-time conditions depreciating according to the age of the property and then appreciating to cover war-time advances. And this appreciation has averaged from 25 to 35 per cent. It has been thought fair to allow such appreciation in view of the fact that there is no assurance that war-time prices will come back to normal in less than possibly 20 years.

SOUTHLAND METER BOXES

A No. 11 oval Southland water meter box is here illustrated. The box forms a combination housing for curb-cock and water meter. The box is of cast iron. Provision is made for securing a lifting hold through removal of the lid. A concrete walk or pavement is not damaged in removing a box of this type. The cover locks with the "wonder" lock, so called because of its simplicity. The unlocking key serves as a handle with which to remove the cover. When the key is removed the cover is automatically locked in position. Only this special key will unlock the cover. All parts of this locking cover are of non-corrosive solid bronze. This Southland meter box is a product of the H. W. Clark Co. of Mattoon, Ill. The Clark Company also manufacture round meter boxes in cast iron and sheet iron, black or galvanized. The round boxes are made in two sizes, 12 and 18 ins. high, respectively.

The Southland box illustrated is in many respects a complete departure from the regular line of meter box construction. Attention is called in particular to the unique combination feature of housing the curb cock in the same box with the water meter, thus eliminating



THE SOUTHLAND WATER METER BOX.

the use and consequent expense of the independent curb cock, making a great saving to the water department.

The plumber has quick and convenient access to the curb cock, but the meter can be reached only by the use of the key required to operate the lock of the box lid.

This box can be lifted straight up after unlocking the lid, so that tunneling may be done on either side for several feet, if need be, to reach and repair a leak under the concrete walk or pavement. The box is then replaced through the original opening required for its setting.

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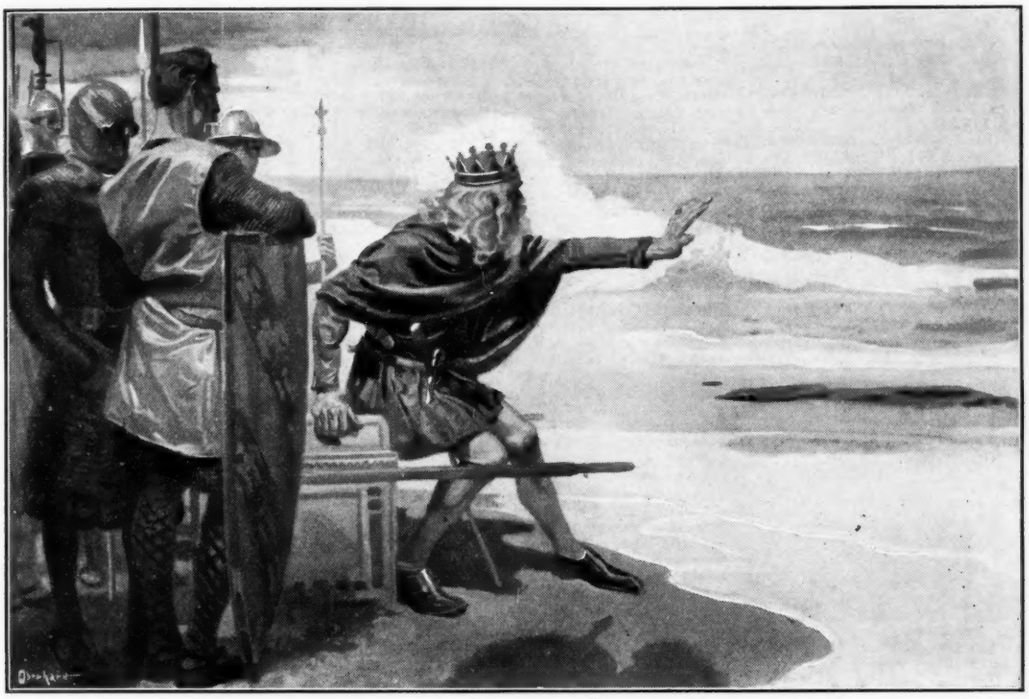

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CONTRACTS AWARDED

ROADS AND STREETS

Ariz., Phoenix—Westcoast Constr. Co., Tucson, awarded contract for construction of Sect. 1-A, Tucson-Florence Hwy., at $109,870.

Ariz., Prescott—Southwestern Constr. Co., Phoenix, awarded contr. for paving Mt. Vernon avenue, at $76,944.

Ark., Augusta—J. A. Burt, Gunnison, Miss., awarded contract for 21 mi. waterbound macadam road, at $415,000; also, 26 mi. asph. macadam road, at $448,000.

Ark., Fayetteville—Phillips Constr. Co., Fayetteville, awarded contr. for constr. of road in Dist. No. 5, at $110,000.

Ark., Helena—Southern Bithulithic Co., Nashville, Tenn., awarded contr. for Helena-Old Town Road, at $450,000—about 15 miles.

Ark., Perryville—G. C. Williams, Perryville, awarded contract for 26½ mi. road; 96,000 cu. yds. grading, at $120,000.

Ark., Pine Bluff—Benton Constr. Co., Pine Bluff, awarded contract for work in Rd. Impvt. Dist. No. 14, Jefferson Co., 42 mi. road bed, at $150,000.

Ark., Pine Bluff—J. A. Perdue, awarded contract for constr. of 20 miles of road from Tamo to Furth, at $300,000.

Ark., Poplar Bluff—Roy L. Williams, awarded contract for conc. hwy. in southeast Missouri, at $461,615.

Ark., Russellville — P. F. Connelley, awarded contr. for 28½ miles of road in Pope County Dist. No. 1, at $480,000.

Cal., Bakersfield—Federal Constr. Co., San Francisco, awarded contr. for paving 21st, 22nd, 23rd, 24th and H streets in Dist. No. 46, with 3-in. asph. base and 1½-in. bithu. surface, at $51,965.

Cal., Fresno—Contracts awarded as follows by Supvrs. Fresno County: 5 miles Warrenite paving to Worswick Constr. Co., Fresno, at $80,339, also, 17 miles on Van Ness avenue, conc. base with Warrenite top, at $5,064; Thompson Bros. Co., Fresno, contr. for 1.21 miles Belmont Ave., at $38,-601, conc. with Warrenite top; Blanchard, Crocker & Howell, San Francisco, contr. for 13.7 mi., White Bridge Ace., at $375,816, also, 10 mi. Ventura avenue, at $300,329; Hugh Crummey, San Francisco, contr. for 4.2 miles Adams avenue, at $110,746.

Cal., Los Angeles—Wm. Liddington, 420 E. 60th St., City, awarded contr. for paving 1st alley south of Third street, betw. Gertrude and State streets, and 1st alley west of Gertrude street, at $2,505; Los Angeles Paving Co., 2900 Santa Fe avenue, awarded contr. for grading and paving Broadway betw. 10th and Pico streets, at 30,531.

Cal., Los Angeles—Wm. Liddington, 420 E. 60th St., awarded contract for improving Francisco avenue, Windsor avenue to Burck Place, at $12,501; for grading and paving section of Coast Blvd., near Segundo, at $21,996; Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., awarded contract for improving Ingraham street, Kip to Little street, and portions of other streets, at $47,595; Los Angeles Paving Co., awarded contract for paving Broadway, 10th to Pico street, at $30,531. Work consists chiefly of Bithu.

Cal., Los Angeles—Fairchild-Gilmore-Wilton Co., awarded contract for paving and perm. impvt. of Ingraham street, also Kip and Little streets, and other streets in the Ingraham Street Dist., at $47,596.

Cal., Sacramento—T. M. Olney, 358 Vernon St., Oakland, awarded contr. for grading and paving with conc. 10.7 miles state hwy. in Amador County, at $66,469.

Cal., Sacramento—McGillivary Constr. Co., awarded contr. for paving X street, at $40,000.

Cal., Sacramento—Geo. R. Curtis, 2440 E. 26th St., Los Angeles, awarded contract for paving with conc. 1.3 miles state hwy., Ventura County, at $25,600; Fred Hoffman, Long Beach, contr. for grading and concpaving 8.6 mi., Los Angeles County, at $191,445; W. A. Dontanville, Salinas, contr. for grading and conc. paving 4.7 mi., San Joaquin County, at $56,000.

Cal., Upland—W. C. Cline, Upland, awarded contract for improving Euclid avenue, 10th to 24th streets, at $94,465.

Cal., Visalia—Federal Constr. Co., San Francisco, awarded contract for paving abt. 2½ miles of city streets, at abt. $160,000.

Colo., Denver—Edw. Honan, Colorado Springs, awarded contr. for dirt grading on Husted Federal Aid project for $12,300. Project includes bldg. 2 conc. brdgs. and several culverts in addn. to grading. Total cost of project, $43,600.

Conn., Hartford—Thos. Kearney, 84 Alcove St., Meriden, Conn., awarded contract for 4,150 lin. ft. 7-in. bit. trap rock macadam on Silver Lane Rd., at $15,142; Jno. P. Maguire, 5 Fairview St., New Britain, Conn., contract for 11,472 ft. conc. constr. on Branchville Rd., town of Ridgefield, at $78,640; C. W. Blakeslee & Sons, 58 Waverly St., New Haven, contract for 5,175 ft. conc. on Short Beach Rd., town of E. Haven, at $26,792; Linberg & Co., 809 Old S. Bldg., Boston, 3,837 lin. ft. conc. rd. on Grove street, town of Putnam, at $31,-468; Lane Constr. Corp., 52 Colony St., Meriden, Conn., 5,364.5 lin. ft. 3-in. bitum. macad. on Bantam Lake Rd., Litchfield, at $23,120; W. H. Arthur, 1 Bank St., Stamford, Conn., 6,300 lin. ft. 3-in. bitum. macad. over 5-in. base, Fairfield, at $26,763; Jno. De Michael & Bro., 58 High St., Torrington, 10,450 ft. 3-in. bitum, macad. on base on Bethlehem & Bantam Lake Rds., Norris, at $50,377; J. H. Grozier & Co., 4,378 lin. ft. 3-in. bitum. macad., Bolton, at $24,414; A. Vito Constr. Corp., Thompson, Conn., 18,410 lin. ft. 3-in. bitum. macad. over 5-in. base, Thompson, at $71,775.

Del., Middletown—Lowe Constr. Co., Philadelphia, awarded contract for bldg. new streets in town, at $45,000.

Fla., Umatilla — Findley Method Co., Jacksonville, Fla., awarded contract for 1½ miles paving on Main street, at $35,000.

Ga., Athens—Smith Constr. Co., Atlanta, Ga., awarded contract to pave 3.18 miles Athens-Winder Rd., at $75,400.

Ga., Monroe—Stanley-Singer Contracting Co., Lafayette, Ala., awarded contract for 8.2 miles sand-clay road on Monroe to Jersey Rd., at $46,145.

Ida., Boise—Grant Smith & Co., Spokane, awarded contract for constr. a portion of the North and South Hwy., from Whitebird to New Meadows, Ida., at approx. $625,000.

Ill., Springfield—Trompeter & Sons, Peru, awarded contract for constr. of Peru-Spring Valley link of the Ivy Way, at $47,777.

Ill., Springfield—Chas. H. Degenhart, Alton, awarded contract for constr. of Sec. Y. of Springfield-E. St. Louis Hwy., Madison County, brick and concrete constr., at $220,000.

Ind., Kendallville—Levi Kiser, Columbia City, awarded contract to constr. 4 miles of road in Allen County, at $65,050.

Ind., Logansport—Martin McHale, Local, awarded contract for bldg. 10 miles gravel roads in Fulton County, at $105,000.

Ind., Noblesville — Pickett & Jessup, Nobles., awarded contract for what is known as the Johns concrete road at $75,-000; Sample conc. road to Mayor McCoun, City, at 53,000.

Ind., Noblesville—H. L. Findley, City, awarded contract for paving with conc. Main street, through town of Arcadia, at $50,000.

Ind., Rochester—Martin McHale, awarded contracts for Oliver Rd., at $48,700; Callahan Rd., $21,590, and Hendrickson Rd., at $33,510.

Ind., Rochester—Jas. B. Waddell, Rochester, awarded contract for constr. of Jacob Kreamer Rd., at $119,700, and the Ray Carr Rd., at $36,300.

Ind., Wabash—Federal Asphalt & Paving Co., awarded contract for impvt. of the La-Fontaine Rd., at $104,444.

Ia., Albia—Jones F. Lee Paving Co., Dubuque, awarded contract for constr. of 22,-000 sq. yds. paving and 11,000 ft. curb and gutter, at $97,801.

Ia., Marshalltown—Peter E. Shugart, Nevada, awarded contract for grading 6 miles primary road system to prepare for paving. Est. cost, $38,928.

Kans., Hutchinson—M. R. Ammerman, Sterling, awarded contract for 5½ miles of paving on Hutchinson-Nickerson-Sterling hard road, at $48,600 per mile.

Kans., Hutchinson—Stamey-Mackey Constr. Co., Local, awarded contract for brk. paving, conc. with asph. filler, at $130,000.

Kans., Leavenworth — Missouri Valley Bridge & Iron Co., City, awarded contract for concrete hard-surfaced road in Leavenworth County, 5¾ mile road, at $166,857.

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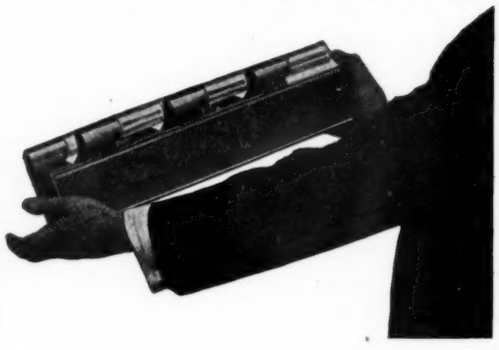

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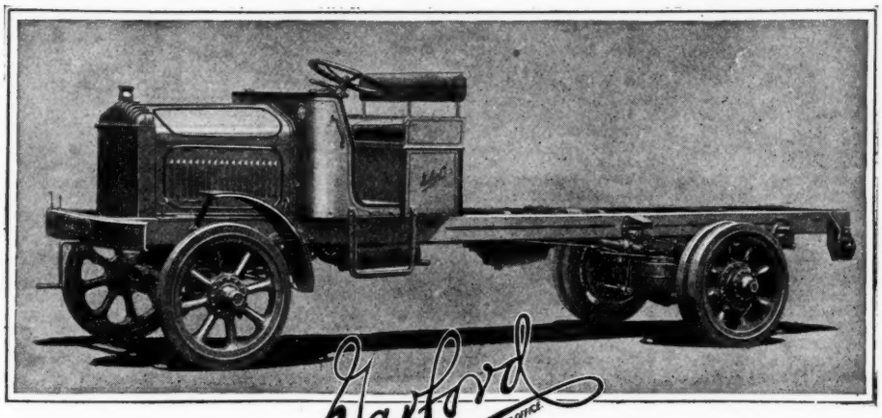

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TRUCKS

Ky., Hodgenville—R. B. Tyler & Co., Louisville, awarded contract for 4 miles of road on Jackson Hwy., at 64,000.

La., Vidalia—S. A. Gano, New Orleans, awarded contract for 8 mile gravel road—Ferryday to Tensas Parish line—$500,000 available.

Md., Baltimore—Allen County awarded contract for improving Allen avenue, Carlisle avenue, Vickers road, 36 street, etc., at $62,655.

Md., Salisbury—Jos. Dainto, Martinsburg, W. Va., awarded contract for conc, roads, $55, 892 available.

Md., Salisbury—E. R. Griffith Contracting Co., awarded contract for 1.03 mi. Salisbury-Snow Hill Rd., Contr. No. 412; 1.07 mi. Salisbury-Nanticoke Rd., Contr. No. 522; conc, pavement, 15ft. wide, $70,000.

Mass., Boston—Warren Bros., awarded contract for bithu, paving in Norfolk street—Corbet to Mascot streets—at 1,489; also, bithu, paving in Market street across Tremont street, Brighton, at $67,203.

Mass., Boston—Jas. Doherty, awarded contract for recut granite blk. and wood blk. paving in Federal street—Milk street to Dewey Square—at $20,972; also, contract for wood blk. paving in Beacon street—Mass. avenue to Raleigh street—at $43,055.

Mass., Boston—Middlesex Constr. Co., Medford Hillside, awarded contract for bldg. section of hwy. 7,100 ft. long, in town of Worthington; also, hwy. 2,900 ft. long, in Northfield, at $51,430.

Mich., Escanaba—Delta County Commrs., awarded contract for macad. rd., 16 ft. wide, 4 miles long, at $44,453. Alk J. Pepin, Clk., Delta Co.

Mich., Lansing—Banhagel Constr. Co., Ionia, warded contract by State Hwy. Dept. for shaping, surfacing and draining 1 mi. State Trunk Line Road No. 10, on cost plus percentage basis; 3.11 mi. State Trunk Line Road No. 26-2, Houghton Co., to Bd. Houghton Co., Rd. Commrs., Dee Bldg., Houghton, at $21,610; 3.094 mi. State Trunk Line Road No. 28-5, Ontonagon Co., involving 25,411 sq. yds. waterbound macad., to J. C. Blomgren, Norway, at $33,960.

Mich., Lansing—Contracts for Michigan trunk line work awarded as follows: 1 mi. macad. rd., through Iron Mountain, Dickinson Co., at $22,429 to Hoose & Pierson; ¾ mi. conc. rd., through Lansing, Ingham Co., to Butler Constr. Co., at $26,714; 3½ miles grading and draining in Sandstone Twp., Jackson Co., to H. E. Wilkinson, Homer, at $22,892; 4½ miles gravel road, Watertown Twp., Sanilac Co., to Bland & Hodge, at $59,301; 1 mile gravel road, through Bloomfield, Isabella Co., to Twp. Board Remus Co., at $14,122; 1 mile gravel road through Deerfield, Isabella Co., to Twp. Bd. Mt. Pleasant, at abt. $16,300; 5 miles macadam road through Ruyyard, Chippewa Co., to Jno. H. Cattle, Rudyard, at $105,-035; 6 miles clearing through Pentland, Luce Co., to Robt. Byers, at $16,183; 1 mile clearing through Soo, Chippewa Co., to A. Rube, Saulte Ste. Marie, at $1,383; 1 mile gravel road through Chester Twp., Otsego Co., to County Commrs., Gaylord County, at $21,326; 5½ miles macadam road through Au Train, Alger Co., to County Commrs. of Munising, at $92,337; 1½ miles gravel road, Alpena Twp. to Alpena County Commrs., at $19,264.

Mich., Midland—H. A. Crane, awarded contract for constr. of Covert gravel road of 5 miles. at $74,000.

Minn., Duluth—Ed. Johnson & Son, awarded contract for impvt. of 22nd avenue, west from Superior to Seventh street, at $62,142.

Minn., Duluth—Riverton Construction Co. (organized by citizens with capital of $50,-000) will construct 35-mile strip of the Wind River Road, betw. Riverton and Jackson Hole, which will afford new route to south entrance to Yellowstone Park. No contractors offered bids on this work hence the organization of construction company by the public-spirited citizens.

Minn., Duluth — Carl W. Stromgren, awarded contract for paving 9th alley from 11th avenue to 12th avenue, E., at $3,414; N. J. Upham Co., Providence Bldg., Duluth, contract for pub. impvt. certifts. Ed. Johnson & Son, Duluth, contract for paving 22nd avenue, west from Superior street to 7th street, at $62,142.

Minn., Eveleth—Lawrence McCann, Local, awarded contract for resurfacing Main St. with Bithulithic and extension of Bithulithic paving to the cemetery, at $100,284.

Minn, Faribault—Joe Samson, St. James, awarded contract for grading job 1904, state road No. 16, 7.1 mi., at $22,000; also, contract for state road No. 2, 12.6 miles grading, at $34,000.

Miss., Columbus—Henry C. Terry, City, awarded contract to pave streets in business section, with cement, at $44,600.

Miss., McComb City—Southern Clay Mfg. Co., Chattanooga, Tenn., awarded contract for paving fire district of McComb City, at $100,000; 18,725 sq. yds. pavement, curb and gutter; storm sewers, vitr. pipe; manholes, catch basins, etc. Storm sewers work let to Chattanooga Sewer Pipe Co.

Miss., Pascagoula—J. T. Galloway & H. N. Bonnabel, awarded contract for 4 mi. conc. road betw. Moss Point and Pascagoula, 18 ft. wide, at $136,345.

Miss., Senatobia—F. D. Harvey & Co., Memphis, Tenn., awarded contract to grade 100 miles of roads, at $200,000.

Mo., Brookfield—Jesse Williamson & C. A. Diemer, awarded contract to pave Brookfield avenue, Linn, Macon and Shelby streets, at $30,000.

Mo., Charleston—Roy L. Williams, Wyatt, Mo., awarded contract for conc. paving of 16 miles of hwy.—Charleston to Birds's Point (just opposite Cairo)—at $461,000.

Neb., Alliance—Sprague & Nicely, Beatrice, awarded contract for paving and installing storm sewers in Box Butte and Laramie avenue, 1st, 2nd, 3rd and 4th streets, 40-72 ft. wide, at $190,163.

Neb., Lexington—Edw. Peterson Co., 1217 W. O. W. Bldg., Omaha, Neb., awarded contract for dirt road; Neb. Culvert Co., Wahoo, contract for culverts; fed. and state aid road—Overton to Cozad, 27½ miles—total of contract, $88,403.

Neb., Lincoln—Abel Constr. Co., 318 Terminal Bldg., Lincoln, awarded contract for about 7 miles paving in Dist. No. 38, at $300,000.

Neb., Lincoln—Abel Constr. Co., 318 Terminal Bldg., Lincoln, awarded contract for one mile of paving from city limits, at $55,400.

Neb., Lincoln—Roberts Constr. Co., Lincoln, awarded contract for constr. of road from station of Peru to state normal road at that place, at abt. $50,000. Paving will be of brk. on cement base.

N. J., Newark—Northern Constr. Co., 423 Amherst St., E. Orange, awarded contract for paving Grove street, at $26,665; Lyons avenue, at $81,792.

N. J., Trenton—M. I. Demarest, Seawarren, awarded contract for bldg, 3,865 sq. yds. State Hwy. Route No. 1, Sec. 1-A, Metuchen Twp., Middlesex Co., at $34,996; Sampson & Reuter, Elizabeth, contract for 11 mi. Abescon-Egg Harbor Road, Route E. 18 ft. wide, Atlantic Co., at $404,000. (Both conc.)

Nev., Carson City—Armstrong & Baker, Elko, Nev., awarded contract for constructing 7.57 mi. state hwy., Letteville to Fallon, Churchill Co., at $45,713.

N. M., Santa Fe—Lea Co. Constr. Co., Lovington, awarded contract for bldg. 5.4 miles Fed. Aid Proj. 16, at $39,517.

N. C., Asheville—Asheville Paving Co., awarded contract for paving Black Mt. Azalea Rd., at $202,181; H. A. Wells, contr. for grading at $81,699.

N. C., Ashboro—Adams, Evans & Co., 30 Church St., New York City, awarded contract for 40,000 sq. yds. sheet asph., bithu. and Topeka paving, at $165,000.

N. D., Lisbon—J. W. Van Orham, Forman, awarded contract for 14.41 miles earth road, at $53,225.

O., Canton — Garaux Bros., Canton, awarded contract to pave section of Sherrick Road, at $30,214.

O., Columbus — Following contracts awarded on 25,515 miles of road work: Sec. A. Carroll Co., Canton-Steubenville Rd., to Phillip Deiffenbacher Co., Massillon, O., at $63.615; Sec. J-2, Clermont Co., Cincinnati-Chillicothe Rd., S. B. Craig, Blanchester, O., at $16,124; Sec. E, Crawford Co., Bucyrus-Crestline Rd., J. W. Carey, Ada, O., at $38,212; Sec. A, Columbiana Co., Lisbon-E. Palestine Rd., to E. E. McCartney, Youngstown, O., at $26,489; Sec. H, Hancock Co., Lima-Sandusky Rd., to S. Jacobs & Son, Findlay, O., at $3,289; Sec. E-2, Perry Co., Zanesville-New Lexington Rd., Foster Richert Constr. Co., Dayton, O., at $10,271; Sec. I, Scioto Co., Portsmouth-Columbus Rd., W. H. Ringwald & Sons Co., Chillicothe, O., (mono. brk.), at $252,285; Sect. A-2, Scioto Co., Portsmouth-Jackson Rd., S. Monroe & Sons Co., Portsmouth, O., at $80.540; Sec A, Brown Co., Ripley-Hillsboro Rd., to H. C. Laub, Amelia, O., at $3,689; Sec. C, Coshocton Co., Coshocton-New Comerstown, to T. J. Noewman & Son, W. Lafayette, O., at $17.931; Sec. D, Geauga Co., Cleveland-Meadville Rd., to Studebaker & Son, Greenville, O., at $36,692.

O., Hamilton—Andrews Asphalt Paving Co., awarded contracts for paving Dixie Hwy., at $125,777; also Shuler avenue, at $55,217.

O., Newark—Fred H. Vogelmeier, Local, awarded contract for bldg. road, at $44,726.

O., Toledo—Harris & Tansey, awarded contract for paving Sylvania avenue, at $92,400.

O., Wapakoneta—Jas. Lynn, Paulding, awarded contract for impvt. of Marys-Celina Road, betw. the two towns, at $153,478.

Okla., Enid—Hyde Constr. Co., Enid, awarded contract for constr. of 44 blocks concrete pavement, at $316,755.

Okla., Collinsville—Standard Paving Co., Tulsa, awarded contract for paving approx. 30,000 sq. yds. vitr. bricks with asph. filler, at $170,285.

Ore., Portland—State Hwy. Comn., let contract for grading 14 mi. Columbia river hwy. across Sherman Co., to Porter & Conley, Ry. Exch. Bldg., Portland, at $207,115; Warren Constr. Co., Journal Bldg., Portland, awarded contract for paving 10.8 mi. Scappoose-Dear Island, Sec. Columbia river hwy., stand. bithu., type E, using gravel on 5 mi. of road, at $229,515.

Pa., Beaver Falls—Columbus Asph. & Paving Co., Citizens Bk. Bldg., Columbus, awarded contract for paving 14th street, 1st to 7th avenues, asph. on conc. base, stone curbing, at 34,875. $

Pa., Harrisburg—Holt Lumber Co., Carbondale, awarded contract to build 6,191 ft. state aid road in Forest City, Susquehanna Co., at $59,462.

Pa., Philadelphia—Following improvement contract let, subject to decision of Supreme Court on validity of $12,907,000 municipal loan: Grading contracts let to Thos. Connor, at $28,636, est. of K. P. Bennis, $2,535; Roy B. Wenner, $1,177; est. David McMahon, $354; Thos. P. Lee, $1,843; Paving contracts let to Eastern Paving Co., $5,690, $7,839; Barber Asph. Paving Co., $3,461; Eastern Paving Co., $4,760, $5,758, $4,319 and Union Paving Co., $3,821. Seven old streets are to be repaved with asphalt: Barber Asph. Paving Co., $11,499; Union Paving Co., $36,403; $37,015; $22,177; Jno. Meehan & Son, $78,017; Cunningham & Murray, $35,-644; Jno. Meehan & Son, $51,589. Benezet street, Creshem Valley Rd. to Phila. & Reading R. R., will be improved with bitum. macadam and contract has been let to Mack Paving & Constr. Co., at $7,880.

Pa., Waynesburg—E. E. Morris, Waynesburg, awarded contract by Commrs. Greene Co., for bldg. conc. and vitr. road from Dry Tavern on Waynesburg Rd., at $319,-732.

S. D., Egan—D. D. Bidwell, Egan, awarded contract for constructing hwy. from Moody County line through Madison, at $106,212.

S. D., Madison—D. D. Bidwell, Egan, S. D., awarded contract for state highway from Moody County line through Wentworth to Madison, at $106,212.

Tex., Columbus—M. M. Craven, Houston, awarded contract for 19.46 mi. Houston-San Antonio Hwy., at $188,331.

Tex., Eagle—M. M. Craven, Houston, awarded contract for bldg. 19.46 miles of Houston-San Antonio Road, at $188,331.

Tex., Granbury—McElwrath & Rodgers, Corsicana, awarded contract for constr. gravel highway No. 10, at $210,000.

Tex., Range—McKenzie Constr. Co., San Antonio, awarded contract to pave 58 blocks of streets with vitr. brick, at $613,000.

Va., Onancock—Capt. Jno. B. Wheelton, awarded contract to construct rd. betw. Chincoteague Island and mainland, by the Chincoteague Toll Rd. & Brdg. Assn., at $144,000.

Va., Wise—Sneed & Trinkle, Norton, Va., awarded contract to grade and drain 55,000 cu. yds. Roaring Fork Rd., at $75,000.

Aberdeen, Wash.—Puget Sound Brdg. & Dredging Co. awarded contract for construction of E. Aberdeen roadway. Contr. calls for bldg. large retaining wall of piling and conc. portion being 440 ft. long and filling the bulkheaded area with 25,000 cu. yds. material dredged from the Chehalis river bed. Company has agreed to charge city cost plus 10 per cent.

Wash., Castle Rock—Henry & McFee, Seattle, awarded contract for impvt. of 7 miles Pacific Hwy., north of here, at $241,317.

W. Va., Charleston—Vang Const. Co., Baltimore, Md., awarded contract for grading and surfacing with gravel 12 miles of road—Cumberland to Romney—at $77,-906.

Wis., Madison—McCullough & Cheney, 440 Temple Court, Minneapolis, Minn., awarded contract for work on Project No. 96—Beloit-Janesville Rd., Rocky Co.—at $162,426.

SEWERAGE AND SEWAGE TREATMENT.

Ark., Blytheville—H. O. Hanson awarded contract to construct storm sewers from Franklin St. 5,000 ft. beyond city limits in W. Blytheville, down Lumerate bayou, the main sewer, at $55,650.

Ark., Helena — Hedges-Weaver-Weeks Constr. Co., Springfield, Mo., awarded contract for sewer and street impvts.; $750,000; conc. base, Warrenite surface, rein. conc. sewer; 4,000 ft. 7 to 9 ft. monolithic sewer.

Cal., Bakersfield — Lloyd S. Stroud awarded contract for constructing sewer in alleys adjoining Tulare St., involving 2,267 ft. 6-in. vitr. pipe at $1.50 ft., 2 conc. manholes at $85 each and 4 lampholes at $10 each.

Cal., Fresno—Thompson Bros. awarded contract for constructing 6-in. lateral sewers in blks. 88 and 89, Fairmont tract, at 66c for sewers, $50 each for manholes and $20 each for lampholes.

Cal., Long Beach—P. S. Tomich, 553 Pacific Ave., awarded contract for constructing vitr. sewers in sewer district No. 8, Long Beach.

Cal., Los Angeles—Leo Miletich awarded contract for constructing sewer in portion of Bayer St., at $2,086; also in Sunset Blvd., at $4,342.

Cal., Newport Beach—C. D. Sotoras, Black Bldg., Los Angeles, awarded contract for constructing cement pipe sewer system and sewage disposal plant, at $225,993.

Ill., Chicago—American Asphalt Paving Co. awarded contract for uncompleted portion of the Rockwell St. system of sewers.

Ind., Evansville—Jno. L. Newman, Evansville, awarded contract for construction of sewers in and along Ocean Ave., and sewer in and along alley in blk. 2, Hartmetz Addn., at $2,807 and 451, respectively.

Ind, Indianapolis—J. H. King & Co. awarded contract by Bd. Pub. Wks. for local sewer in Minnesota St. and Sheffield Ave.; Pershing Ave. to alley north of McCarty St., at $5.54 lin. ft., or total of $109,331.

Ia., Livermore—Mr. Crowley awarded contract for constructing sewerage system; also large number of water mains. Cost of contract about $40,000.

Ia., Livermore—National Constr. Co., Davenport, awarded contract for sewers, at $28,802; disposal plant to Ward & Weighton, Davenport, at $11,439.

Ia., Mason City—Clark-Smith Co. awarded contract by Mason City Council for lateral sewer to be constructed in Forest Pk. Addn., at $13,557.

Ia., Pocahontas—J. W. Turner Constr. Co., 309 Youngerman Bldg., Des Moines, Ia., awarded contract for sewer system, at $109,608; disposal plant to R. C. Digel, Webster City, at $21,900.

Ia., Red Oak—E. B. Corey, Shenandoah, awarded contract for 8,600 ft. of sewer constr., at $10,200.

Ia., Rockwell City—Carl Schlachter awarded contract for sewage treatment plant at Women's Reformatory, at $10,116.

Ia., Sioux City—F. T. Leeder, 619 5th St., Sioux City, awarded contract for sanitary sewers in various streets, at total cost of $48,372.

Ia., Wall Lake—Moore-Sieg Co., Waterloo, awarded general contract for sewers and disp. plant, at $13,330.

Kans., Chapman—Reed & Wheelock, Clay Center, Kans., awarded contract for constr. of sanitary sewers and storm drains, at $53,040.

Kans., Hutchinson—C. H. Everett, local, awarded contract for constr. of sanitary sewers in Enterprise, Kans., at $32,440.

Ky., Louisville—Geo. M. Eady and K. A. Barker awarded contract by Board of Awards for 5 sewers, $8,700; portion of 26th St., Mary St., Magazine St., Marlowe Pl. and 15th St. City will furnish $5,000 worth of pipe.

Mass., Boston—Antony Cefalo awarded contract for sewerage works in Tenean St. and private land, Dorchester, at $5,410.

Mass., Chicopee—Cordner & Montague, 373 Bay St., Springfield, awarded contract for laying vitr. pipe sewer in Exchange St., at about $37,500.

Mich., Grosse Pointe Farms—Walker-Teetaert Co., 919 Majestic Bldg., Detroit, awarded contract for furnishing and laying 8,435 ft. 10 to 36-in. pipe for storm sewers, at $50,000.

Mich., Royal Oak—C. Tackels, 918 Dickenson Ave., Detroit, awarded contract by Vinsetta Land Co., for labor and material for bldg. sewerage system and disp. plant, involving 2,200 ft. 8-12 in. vitr. crock sewer, Imhoff tank ejectors, sprinkling filters, etc.

Minn., Duluth—Commrs. ordered sanitary sewers constructed by Day Labor in 5th St., 24th Ave. west to alley east of 25th Ave. W., $1,197; also in 58th Ave. W. to Highland St., and 18th Ave. W. to 47th Ave., $2,075. J. A. Farrell, Commr.

Minn., Duluth—Johnson & Hiner awarded contract for sanitary sewer on 105th Ave. W., from House to McGonagle Sts.; John Boise, contr. for sanitary sewer in 39th Ave. W., at $1,395; John Hedberg, Duluth, contr. for storm sewer on E. Superior St., at $23,113.

Minn., Duluth—Hiner & Johnson awarded contract for sanitary sewer, at $1,376; C. R. McLean & Son, contract for outlet sewer, at $11,772. City will construct sanitary sewer in Avondale St. by day labor. Est. $1,650. J. A. Farrell, Commr.

Minn., Holdingford—Illstrup & Olson, Minneapolis, awarded contract for sewers.

Minn., Lamberton—Kircher Bros., Olivia, Minn., awarded contract for sewers; 17,000 lin. ft. sewer tile, 10 lampholes and 5 manholes.

Minn., St. Paul—Christ Johnson, 506 Harrison Ave., awarded contract for constr. of sewer in Osceola Ave., at $4,293.

Minn., Stephen—Chas. Anderson, Warren, awarded contract for sewers in Riverside Addn.

Minn., Thief River Falls—Holt & George, local, awarded contract for storm sewers and sewer and water connections, at $26,000.

Miss., Drew—H. C. Perry, Bessemer, Ala., awarded contract for constr. of sewers, pumping stations and disposal plant. J. H. Weatherford, Engr., 64 Porter Bldg., Memphis.

Miss., Greenville—J. W. Billingsley, New Orleans, awarded contract for sewer extension and improvements, at $75,000.

Miss., Greenville—Foundation Co., New Orleans, awarded contract for extension of sewer system, to cost $75,000.

Mont., Billings—E. Lindstrom, Billings, awarded contract for 32,000 ft. of 8-in. sanitary sewer, at $72,140.

Mont., Judith Gap—Security Bridge Co.,

USED ROAD BUILDING EQUIPMENT FOR SALE
AT REDUCED PRICES

1—Cummer 2000-yard Railroad Car Asphalt Plant.
1—Cummer 1800-yard Road Asphalt Plant.
1—Twelve-Ton, 24-inch Gauge, Geared Locomotive.
6—Road Rollers, 2½, 8 and 10-ton.
1—Noyes Crusher for Re-working Old Asphalt.

2—Brand New Traction Road Cranes, full Revolving.

Locomotive Cranes, Hoisting Engines, Buckets, Dump Cars and Other Equipment.

F. MAYER

53 W. Jackson Blvd. **CHICAGO, ILL.**

Billings, awarded contract for sewer and water main extensions, at about $30,000.

Neb., Blair—Hansen & Walladsen Co., awarded contract for constr. of sewer system, at $24,865 for mains and $62,063 for laterals.

Neb., Creighton—E. M. Scheflow, Elgin, Ill., awarded contract for sanitary sewer system, at $39,815.

Neb., Harvard—Dunlop & Co., Tecumseh, Neb., awarded contract for sewer system, at $57,695.

Neb., Newman Grove—A. A. Dobson, Lincoln, awarded contract for building sewers in various streets, involving 22,070 ft. 8-15 in. vitr. pipe, at about $29,500.

Neb., Omaha—J. Jensen, 2407 Wirt St., awarded contract for building 1,075 ft. storm sewers in Railroad St., Washington to Gilmore Sts., involving 7 ft. 12-24 in. vitr. clay pipe and 1,584 lb. c. i. pipe, etc., at $17,920; 32,316 ft. storm sewers, Florence Twp., involving 28,386 ft. 8-24 in. vitr. clay pipe, 3,920 ft. 2-3 ft. segement blk., 102 manholes, 5 flush tanks, 58,976 lb. c. i. pipe, eyc., at $82,229.

Neb., Wilbur—Martz Constr. Co., Bankers Life Bldg., Lincoln, awarded contract for sewer, at $42,880.

N. Y., Rochester—W. E. Kinney & Co., contract for Clifford Ave. sewer, at $86,641; Oliver Costich Co., Federal St. sewer, walks and grading, at $75,310.

N. C., Charlotte—Stancill & Bro. awarded contract for sewer system in Elizabeth suburb, at $5,000.

N. C., Spring Hope—J. B. McCrary, Atlanta, Ga., awarded contract for $20,000 sewer constr.; 3 mi.; 1,200 ft. 10-in. No. 1 sewer pipe; 15,000 ft. 8-in. No. 1 sewer pipe; 23 manholes; 7 flush tanks; 300 Y's; septic tank and liquid chlorine treatment plant. John J. Wells, Engr., Rocky Mount, N. C.

N. D., Carrington—Haggart Const Co., Fargo, awarded contract for sewer and water extensions, at about $20,000.

Ohio, Cincinnati—McLane Bros., Newport, awarded contract to construct sewers in Richmond, Ky., at $70,000.

Ohio, Hamilton—Gessner Co., Toledo, awarded contract for constructing sanitary sewers in Hoover, Clinton, Van Hook, Tiffan, Weller, Minor, Symmes and Bell Aves., at $22,587.

Ohio, Wooster—Dominic Bartholomew, city, awarded contract to construct the Amelia Ave. sanitary sewer, at $2,975.

Ohio, Youngstown—A. P. O'Hara awarded contract for constr. of Jones St. sewer, at $3,753; also Clinton St. sewer, at $766.

Okla., Chandler—V. Long, Oklahoma City, awarded contract by city for E. Chandler sewer extension.

Okla., Claremore—Orings & Shoner, Miami, awarded contract for building 1,400 ft. 8-in sewer in Main St., at about $62,000.

Okla., Frederick—Healy Constr. Co., Dallas, Tex., awarded contract for installing sewage disp. plant in city (Imhoff system), at $20,000.

Pa., Grove City—Weaver & Thomas, local, awarded contract for sewers on Riverside Ave. and Grave St. Riverside sewer will be laid with 8-in. pipe; 385 ft. 6 to 8 ft. deep, 124 ft. 4 to 6 ft. deep, and 113 ft. 2 to 4 ft. deep; Grace St. sewer embraces 150 ft. ditch 4 to 5 ft. deep, 223 ft. ditch 1 to 7 ft. deep.

Pa., Hanover—C. Rees, James street, awarded contract by City for building sewer in E. Washington St., at $26,879.

Pa., Philadelphia—Municipal Disposal Co., Philadelphia, awarded contract for constr. of new sewage disp. plant, at $137,980.

Pa., Pittsburgh—City let contracts for laying 100 ft. 9-in. vitr. and 750 ft. 12-in. rein. conc. sewer in Fallowfield Ave. to F. & F. Diulus, 40 Boundary St., at $2,420; 941 ft. 15-in. rein. conc. sewer in Grandview Ave. to Critelli, Ricca & Zapp, 219 13th St., Sharpsburg, at $3,982; 204 ft. 10-in. rein. conc. and 2,130 ft. 8-in. vitr. sewer in Richmond St., and 1,400 ft. 15-in. rein. conc. sewer in McCandless Ave. to Manella & Lucenti, 6610 Rowan Ave., at $5,326 and $5,025, respectively.

Pa., Sharon—Wm. McIntyre & Sons awarded contract for sewers in McClure Ave., Woodrow Court and Griswold Ave.

Tenn., Nashville—Gould Contracting Co., Nashville, awarded contract for Brown's creek intercepting sewer at $69,228; R. D. Smith, Nashville, contract for Richland creek intercepting sewer, at $21,742.

Tex., Dallas — Standard Constr. Co. awarded contract for storm sewers in Winnetka Heights District, at $237,902.

Tex., Denton—J. M. Gurley awarded contract for storm sewers and paving, at $300,000.

Tex., Gorman—Winslett-Eldredge Constr. Co., Dallas, awarded contract for sewer and water systems; disp. plant; daily capy. 500,000 gals. sewage, at $200,000.

Tex., Houston—F. C. Youmans Constr. Co. awarded contract for constr. of sanitary sewer on Caroline St., Eagle Ave. to Alabama Ave., at $3,000.

Tex., Van Alstyne—Jones Contracting Co., 122½ W. Okla. Ave., Guthrie, awarded contract for sanitary sewers, Imhoff tank and sprinkling filters, at $31,000; disposal plant, at $9,000.

Va., Norfolk—Aronberg & McDonald, 313 Citizens Bk. Bldg., awarded contract for 4,500 cu. yds. sewer system, water works, paving, at $38,798.

Va., Richmond—H. L. Driscoll awarded contract to Clay St. sewer, Sheppard to High Point Sts., at $6,020; C. M. Henley, Fourth St. sewer, Maury to Morgan Sts., at $1,556.

W. Va., Huntington—Stender Construction Co. awarded contract to construct sewer between Jefferson Ave. and Balt. & Ohio R. R., from Kincaid line to 7th St. west.

W. Va., Martinsburg—H. C. Brooks Co., E. Washington St., awarded contract for building sewer disp. plant and sewerage system in John King and cross streets, at $50,331.

W. Va., Martinsburg—Cox Constr. & Lumber Co. awarded contract for sewage disposal plant, at $48,000.

W. Va., S. Charleston—McNichols Co., 924 S. Kilbourne Ave., Chicago, awarded contract for installing complete sewerage system.

W. Va., Warwood—P. G. Gilligan awarded contract for sewers, paving, etc., at $25,000.

Wis., Appleton—H. L. Wilson, 861 Drew St., awarded contract for laying sewers in College Ave., involving 660 ft. 15-in. pipe, at $2.12 per ft.; 663 ft. 12-in. pipe at $1.86, and 667 ft. 10-in. pipe at $1.69.

Wis., Beloit—Logan & Giartz, Elgin, Ill., awarded contract for sewers in Gerald, Partridge, Strong, Ashley, Park and Bayliss Aves.; also Middle St. and Roosevelt Ave., at $6,200.

Wis., Burlington—J. L. Stokes, Elkhorn, awarded contract for constr. of 4,000 ft. storm sewer on various streets, at $9,528.

Wis., Elkhorn—Frank Cazil, Waukesha, awarded contract for sewers: pumping station to Yeomans Bros. Co., 231 Institute Pl., Chicago, Ill.

Wis., Janesville—B. W. Muelhullen, Rockford, Ill., awarded contract for sewer construction, at $12,000.

Wis., Milwaukee—Geo. E. Zimmerman awarded contract for construction of extensions to intercepting sewer system, at $26,767.

Wis., Viroqua—W. F. Ribbens, Mayville, Wis., awarded contract for 10-in. sewer, at $1.82; 8-in., at $1.65; 6-in., at $1.40; manholes, at $86; water pipe, 8-in., at $1.20; 6-in., at $1.15; 4-in., at $1. Total, $13,306.

Wis., Chippewa Falls—P. L. McQuillion Co., local, awarded contracts for sewer construction, at $80,000.

WATER SUPPLY AND PURIFICATION

Ark., Little Rock—Guy Watkins, of engineering firm of Dickinson & Watkins; also E. P. Stanfield, vice president of Ark. Hydro-Electric Power Development Co., awarded contract for drilling several hundred holes to locate foundation for proposed dam on Little Red River. Dam is to be constructed by the hydro-electric company in White Co., at a point equally distant from Searcy, Kensett and Judsonia. First unit will cost $300,000. Contract for dam will be let as soon as Board of Directors meet. Dam will be 45 ft. high from low water mark, 700 ft. long, 45 ft. wide at bottom and 8 ft. wide at top; expected to develop 2,500 h. p.

Colo., Colorado Springs—L. B. Morrison awarded contract for installing settling tanks as part of the chlorination plant at Brookside water intake in So. Cheyenne Canon.

Ga., Savannah—Layne & Bowler awarded contract for new artesian well, to be placed in park extension.

Ill., Chicago—Following contracts for water service pipes in various streets let to Daniel Hardin (Warrant Nos. 47230, 47240, 47241 and 47243); Washington Plumbing & Heating Co. (Warrant No. 47241).

Ill., East Moline—H. J. Schmidt awarded contract for water main in new Park View Addn., at $6,565.

Ill., Lockport—J. P. Miller Artesian Well Co., 430 Orleans St., Chicago, awarded contract for drilling artesian well at site of new Illinois State Penitentiary, at $7,600.

Ind., Anderson—Hill Pump Works, of the Midwest Engine Co., awarded contract for 70 large type pumps with 20-in. discharge and lifting capacity of 13,000 gal. of water a minute, amounting to approx. $100,000.

Ia., Calmar—Messrs. Broghamer & Kittlesby, local, awarded contract for water main extensions.

Ia., Emmetsburg—J. P. Jennings, city, awarded contract for labor in laying 12,000 ft. water mains at Ruthven; Leighton Supply Co., Fort Dodge, contract for the material; total amount of contracts, $16,000. Bid provides for 9,000 ft. 4-in. mains; 750 ft 2-in. and 2,240 of 1½-in.

Ia., Harlan—J. M. Kemp, Harlan & Omaha, Neb., awarded general contract for pump house, at $7,449.

Ia., Lake City—Pittsburgh-Des Moines Steel Co., 1st and Tuttle Sts., Des Moines, awarded contract for water works system and $43,900 reservoir, 200,000-gal.

Ia., Sioux City—Keefe Constr. Co., 406 United Bank Bldg., Sioux City, awarded general contract for Lowell Pumping Station No. 3, at $6,500.

Md., Hyattsville—Deverall-Spencer Co., Garrett Bldg., Baltimore, awarded contract for building conc. tanks and substruct. for water purification works and pumping station, at $11,766.

Mass., Boston—M. DeSisto Co. awarded contract for laying water pipes in Scotia St., Germain, Dundee, St. Cecelia and Peterborough Sts., at $6,102.

Minn., Duluth—National Cast Iron & Foundry Co. awarded contract for 200 tons c. i. pipe, at $12.750; Johnson & Hiner awarded contract for water and gas mains in House St., at $5,550.

Minn., Elk River—Phelps-Drake Co., Hibbing, awarded general contract for water works system.

Minn., Foley—Pastoret Constr. Co., 510 Lyceum Bldg., Duluth, awarded contract for water works system.

Minn., Lakefield—J. G. Robertson, 2528 University Ave., St. Paul, awarded contract for pumping plant for Water & Electric Light Depts., at $4,300.

Minn., Mountain Lake—J. G. Robertson, 2528 University Ave., St. Paul, awarded contract for pumping plant for water system, at $4,300.

Minn., Pipestone—Following contracts let: E. R. Fields, for water mains W. Centennial St. extension, $7,813; Rahr & Pratt, $5.272, same; conc. tower and reservoir to W. S. Hewitt, 530 Met. Bank Bldg., Minneapolis, at $33,650; and pumping plant, Merkel Machy. Co., 508 Interstate Bldg., Kansas City, Mo. Alt. bids, $22,500 and $29,500.

Minn., Redwood Falls—Wm. C. Fraser, Guardian Life Bldg., St. Paul, Minn., awarded contract for water mains.

Minn., St. Cloud—J. P. Munsinger, St. Cloud, awarded contract for water works impvts. in sections of St. Germain St., 2nd Ave., 3rd Ave., 4th Ave., 4th St., and One-half St.

Minn., Thief River Falls—Holt & George, Thief River Falls, awarded contract for water and sewer connections; also storm sewer, at about $26,000.

Minn., Walker—Woldrich Constr. Co., Metropolitan Life Bldg., Minneapolis, awarded contract for extending water supply system, at $25,558.

Mo., Marysville—Randall Constr. Co., Kansas City, awarded contract for building 2 reservoirs, rein. conc. coagulatory plant, rein. conc. storage plant, 2 600 g. p. m. motor-driven pumps, and 1 7,000 g. p. m. low-service pump, at $35,500.

Mo., Weston—C. P. Breen, Parkville, awarded contract for constr. of water works system, at $25,000.

Mont., Musselshell—Security Bridge Co., Billings, awarded contract for water works system, drilled well, 50,000-gal. reservoir and mains; work to be completed in January.

Mont., Townsend—Standard Constr. Co., Bozeman, awarded general contract for water system.

Mont., Butte—Contract let for pipe line from Big Hole River to Butte, doubling water supply. Eugene Carroll, Engr. Butte Water Co. Reserve water supply of 16,000,000 gals. per 24 hrs. Contract for steel pipe, 298,000 lbs., consisting of 3,674 ft. 24 and 26-in. matk. to National Tub Co., and welding joints to B. A. Edwards, Helena. Work will start in spring.

Mont., Judith Gap—Security Bridge Co., Billings, awarded contract for water main extensions; also sewers, at about $30,000.

Neb., Bridgeport—Gordon Constr. Co., Denver, Colo., awarded contract for furnishing pipe, hydrants, valves and installing same, for extending water works and boring one well here, at $10,136.

Neb., Broadwater—F. Black, local,

awarded contract for labor, and Gordon Constr. Co., Denver, Colo., contract for constr. of water works and electric light improvements.

Neb., Hastings—A. A. Dobson Co., Lincoln, awarded contract for labor and materials for 8,847 lin. ft. water mains and 14,544 lin. ft. sewer, at $30,813.

Neb., Lincoln—J. M. Deffenbaugh awarded contract for laying water main and installing hydrants in fire district No. 2, at $26,946.

Neb., McCook—Katz Constr. Co., 640 Brandeis Theatre Bldg., Omaha, contract for water works extension, at total cost of $14,677.

N. J., Kearney—Tippett & Wood, Phillipsburg, awarded contract for new water tower and tank at Soldiers' Home, at $3,000.

N. Y., Albany—Scott Bros., Home, N. Y., awarded contract for dam and reservoir and appurts. for Marcy Div. of Utica State Hospital, at $158,914.

N. C., Spring Hope—Pittsburgh-Des Moines B. & L. Co. awarded contract for tank and tower; J. B. McCrary Co., Atlanta, Ga., contract for water lines and hydrants. Total cost, $40,000.

N. C., Wendell—Tucker & Laxton, Realty Bldg., Charlotte, awarded contract for building deep well, steel tower and tank; also laying 4 miles 6-10-in. water mains and 5 miles 8-15 in. sewers, at about $90,000.

N. D., Casselton—T. J. Arnold awarded contract for sinking wells to furnish city with water.

N. D., Fargo—C. H. Porrit, Fargo, awarded general contract for extension of Moorhead water mains.

N. D., Fargo—W. E. Kennedy, Fargo, awarded general contract for sewers and water mains, at $9,700.

Ohio, Akron—J. D. Kuhn, Barberton, O., awarded contract for laying water pipes here, at $12,403.

Ohio, Canton—E. J. Lander Co., city, awarded contract for constr. of the new 1,500,000 gal. capy. receiving basin at Dan Smith farm, at $47,428.

Okla., Ada—American C. I. Pipe Co. awarded contract for approx. 62,300 lin. ft. Cl. B. c. i. water pipe, ranging in size from 4-in. to 14-in. in diameter, at about $97,000; Darling Valve & Mfg. Co. awarded contract for furnishing 44 fire hydrants and 82 valves, ranging in size from 4-in. to 14-in., at $5,442.

Okla., Ada—Markle Machinery Co., Kansas City, Mo., awarded contract for furnishing and erecting service and fire pumps, all piping and valves, as part of plans for water works extensions, at $20,500. Johnson & Benham, Consit. Engrs., Kansas City, Mo.

Okla., Covington—Mackintosh-Walton Co., 1022 State Natl. Bank Bldg., Oklahoma City, awarded contract for building water works and sewerage systems, at cost plus percentage basis.

Okla., Hartshorne—S. S. Sherman Mach. & Iron Wks., Oklahoma City, awarded contract for water purification plant complete, capy. 500,000 gal. per day, at $23,000.

Pa., Philadelphia—Ames Iron Co., city, awarded contract for furnishing & installing complete at Queen Lane Pumping Sta., 4 turb. centrif. pumping units, at $127,390.

R. I., No. Scituate—G. T. Seabury, Inc., 44 Washington St., Providence, awarded contract for building outlet works at Moswansicut Pond, 9 miles west of Providence, near proposed Scituate reservoir, at $6,987.

S. D., Eureka—Norbeck & Nichols awarded contract for drilling artesian well, at $18,200; Fred E. Peterson, Aberdeen, conc. reservoir; Handel Plumbing Co., Aberdeen, contract for pumps.

S. D., Mobridge—Mobridge Heating & Plumbing Co. awarded general contract for about 15 blocks of water mains.

S. D., Wilmot—W. D. Lovell, 1415 8th St., Se., Minneapolis, Minn., awarded contract for water main extensions.

Tex., Arlington—W. H. Nichols, Dallas, awarded contract for constr. of concrete reservoir and foundation for tower.

Va., Norfolk—Aromberg & McDonald, 313 Citizens Bank Bldg., awarded contract for 4,665 lin. ft. water system, sewer system and paving, at $38,798.

Wash., Toppenish—Standard Asphalt Co. awarded contract for extending water mains on N. Beech and other streets, at $4,204.

Wis., Racine—E. R. Harding Co. awarded contract for digging and backfilling water main in Grand Ave. and 21st St.

Wis., Viroqua—W. F. Ribbens, Mayville, awarded contract for water mains and sewers.

Wyo., Greybull—Standard Plumbing Co. awarded contract for laying 3,000 ft. of water mains.

BRIDGES AND BUILDINGS

Ala., Birmingham—F. M. Dobson, Montgomery, Ala., awarded contract for 100-ft. conc. gird. type bridge in 4 spans on Birmingham and Warrier Rds., State Rd. No. 1, at $14,560.

Ala., Birmingham—A. F. Bearden awarded contract for building 100-ft. span rein. conc. bridge over Rock Creek, on Taylor's Ferry Rd., at about $19,000.

Ark., Marion—Larimer & Burgess, Memphis, Tenn., awarded contracts for 42 bridges and culverts; 550 lin. ft. plate-girder bridges; $1,500 lin. ft. conc. viaduct; $212,000. Crittenden Co.

Cal., Los Angeles—Ross Constr. Co., San Diego, awarded contract for constr of 2 rein. conc. bridges on Brand Blvd., over Verdugo, Wash., at $29,863. Bridges will be each 24 ft. wide and 90 ft. long, girder type, No. 3 spans, conc. piers and abutments.

Cal., Martinez—E. H. Martin awarded contract to constr. rein. conc. bridge over San Pablo and Wild Cat Creeks, at $9,772; A. J. Crier awarded contract for constructing San Ramon bridge, at $17,790.

Cal., Modesto — E. Green, Modesto, awarded contract for building 1,400 ft. concrete gird. bridge over Merced River, having 31 spans with rein. conc. pile foundation, at $112,600.

Cal., Modesto—Cotton-MacCauley Co., Modesto, awarded contract for building 20 conc. bridges for irrigation laterals and creeks in various sections of Stanislaus Co., at $61,294.

Cal., Red Bluff—C. E. McCartney, Red Bluff, awarded contract for Eliza and Brush Creek bridges, at $10,722.

Cal., Redwood City—C. J. Lindgren, Burlingame, awarded contract for building 3 bridges over Redwood Creek, on Maple Ave., Broadway Ave. and on Webster St., at $26,543.

Fla., Punta Gorda—Murphy & Maloney awarded contract for building bridge across

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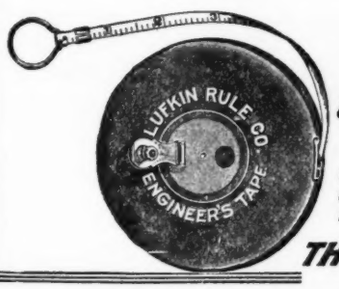

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bay between here and Charlotte Harbor, at $78,000.

Ga., Dalton—Luten Bridge Co., Indianapolis, Ind., awarded contract for bridge over Mill Creek and bridge over Swamp Creek, at 10,169.

Ida., Boise—U. S. Bridge Co., Great Falls, Mont., awarded contract to construct the Homedale bridge, at $89,994.

Ida., Twin Falls—Chas. H. Mull awarded contract for Rock Creek bridge, at $48,850.

Ill., Springfield—J. J. Wuellnor & Son, Alton, awarded contract by Dept. Public Wks. and Bldgs. for construction of bridge at state colony for epileptics at Dixon, at $11,385.

Ill., Springfield—Following Bridge contracts let by Dept. Public Wks. and Bldgs.: Keller bridge, Christian Co., to A. O. McCoy, at $20,700; Knudson bridge, Johnson Twp., Christian Co., to W. C. Johnson, at $4,600; Fowler bridge, Stark, Co., to C. O. Capperrune, at $2,109; Artesia No. 40, in Ford Twp., Iroquois Co., to Continental Bridge Co., at $2,175.

Ind., Noblesville—National Concrete Co. awarded contract by Bd. Co. Commr. for 600-ft. bridge over White River, at $55,908.

Ind., Indianapolis—Following contracts awarded for bridges in Marion: National Conc. Co., Illinois St. bridge, at $25,860; E. F. Smith & Co., 5 smaller bridges, E. 46th St., Lawrence Twp., at $1,462; 2 on Shadeland Rd., at $1,248 and $1,378, respectively; one on Rice Rd., Warren Twp., at $1,135.

Ia., Clarinda—Pittsburgh & Des Moines Steel Co. awarded contract for bridge at Coin, at $22,000.

Ia., Rockwell City—Iowa Bridge Co., Des Moines, awarded contract for constr. of pony truss bridge over Lake Creek, Logan Twp., at $7,619.

Kans., Bonner Springs—A. J. Kopler, 700 W. 12th St., Kansas City, awarded contract for building 100 ft. steel pony truss bridge, 22 ft. wide, conc. flooring and abutments, at $10,800.

Mass., Salem—J. F. Rollins, 6 Beacon St., Boston, awarded contract for building bridge over Ipswich River at High St., in town of Topsfield, at $25,049.

Mich., Bessemer—L. Ericson, local, awarded contract for trunk line bridge No. 287, Crystal Falls Twp., Iron Co., over Brier Hedge Creek, 40-ft. rein. conc. girder, at $4,980.

Minn., Duluth—Stack Constr. Co., Sellwood Bldg., awarded general contract for rlc. bridge over Tischer's Creek, at First St., at $11,425.

Minn., Moorhead—John A. Jardine, Fargo, N. D., contr. for bridge over S. Buffalo river on Moorhead-Barnesville state road so. of Selin, at $19,897.

Minn., Granite Falls—M. A. Adams & Co., 927 Andrus Bldg., Minneapolis, awarded general contract for bridge 3106, at $13,250, No. 3050, at $4,874.

Mont., Great Falls—Porter Bros., Bway and Hardesty Rd., Seattle, Wash., awarded contract for building 970 ft. conc. bridge, 42 ft. wide, on First Ave., and 1,200 ft. conc. bridge, 44 ft. wide, on 10th St., both over Missouri River, at about $242,000 and $232,000, respectively.

N. M., Santa Fe—Midland Bridge Co. awarded contract for concrete bridge with 60-ft. span over Arroyo Mascaros, at cost of $12,000.

N. Y., Schenectady—Walsh Constr. Co., Herald Bldg., Syracuse, awarded contract by Bd. Pub. Wks., Albany, for building abutments and approaches on Schenectady-Scotia bridge, rein. conc., extending from jct. of State St. and Washington Ave. across Barge canal Term. channel, Van Slyck Isl. and Scotia channel, to point about 300 ft. no. of jct. of Schonowee & Mohawk Aves., Scotia Village, at $335,815.

N. Y., Watertown—Peckham Constr. Co., Niagara Life Bldg., Buffalo, awarded contract for building rein. conc. and steel bridge over Black River, on Court St., at $335,815; Walsh Constr. Co., Herald Bldg., Syracuse, awarded contract for building 2-span rein. conc. and steel bridge, 200 ft. long, 39 ft. wide, over Black River, on Factory St., at $53,900.

N. C., La Grange—Roanoke Iron & Bridge Works, Roanoke, Va., awarded contract for steel hwy. bridge 348 ft. long, with draw span, conc. and steel superstruct., over Neuse River at Rockford Crossing; conc. piers and abutments, 16-ft. rdway, $38,000.

Ohio, Columbus—Columbus Sheet Metal Works, superstruct. over Rocky Fork Crk., at $2,515; E. M. Scully, superstruct. for Hayden Run bridge, at $4,700; Columbus Sheet Metal Wks., new floor for Black Lick bridge, at $4,790.

Okla., Inola—Sullivan & Beecher, Wagoner, awarded contract for building steel bridge over Verdigris River here, at about $30,000.

Pa., Beaver—McDonald & Hartman, Rochester, awarded contract for Darlington Road bridge, at $16,000.

Pa., Harrisburg—Central Constr. Corp., city, awarded contract for State Soldiers' & Sailors' Memorial bridge over the Susquehanna River, at $2,384,458.

Pa., Harrisburg—State Hwy. Commr. L. S. Sadler awarded following contracts: The O. B. S. Co., Philadelphia, bridge in Susquehanna Co., Harmony Twp., at $2,691; also in Oakland Twp., $1,686; Wyoming Co., Lemon Twp., $2,261; Sullivan Co., Davidson Twp., for $6,076, to Croton Bridge Co., and Louis Costa, Bacherson Run, for bridge in Fayette Co., at $3,431.

Pa., Meadville—Howard S. Wasson & Son, local, awarded contract for 2 new bridges to be built in Crawford Co., one over French Creek at Saegertown 2.7 ft. long, at $4,200, the other over Conneaut Creek at Conneautville, Pa., at $3,800.

Pa., Stewartstown (York)—Wagman Bros., Dallastown, awarded contract for building 178 ft. rein. conc. arch bridge, 17 ft. wide, stone pier, at about $16,000.

Pa., Wilkes Barre—G. W. Rockwell, Sunbury, awarded contract for building 174 ft. steel bridge with 3 piers over Black Creek, 18 ft. wide, at $49,100.

S. C., Charleston—Jefferson Constr. Co. awarded contract for bridge over Folly River and Folly Creek, connecting James and Folly Islands, at $75,000.

S. C., Chester—Birmingham Steel Corp. awarded contract for constr. of steel bridge at Lockhart, on Broad River, at $37,000; Lockhart Power Co. awarded contract for conc. substructs. of bridge, at $26,039.

Wash., Colfax—H. C. Mallott, Seattle, awarded contract for erection of new steel bridge over So. Palouse River, at Wall St., at $3,245.

Wash., Olympia—State Hwy. Bd. let contracts for building 300-ft. steel bridge approaches over Quinault River, Grays Harbor Co., involving 200 cu. yds. conc., 253,599 lbs. struct. steel and 7,400 lbs. reinforcing steel, to R. E. Meith, Portland, at $44,181; 75 ft. rein. conc. arch.

Wash., Olympia—Union Bridge Co., Seattle, awarded contract for constr. of the Nesika bridge over Cowlitz River, on State Road No. 5, at $37,225.

Wash., Olympia—Illinois Steel Bridge Co., Hutton Bldg., Spokane, awarded contract for building 190-ft. steel bridge with approaches over White Salmon River here. Skamania and Klickitat Cos., at $35,960. Work involves 445 cu. yds. conc., 4,500 lbs. reinforcing bars and 1,300 lin. ft. wood piling.

Wash., Richmond—Union Bridge Co., foot of Fenwick and Kenton Sts., Portland, awarded contract for building 190 ft. steel span bridge over Yakima River, between here and Kennewick, at about $45,000.

W. Va., Fairmont—John F. Casey Co., Pittsburgh, Pa., awarded contract to complete bridge over Monongahela River, 1,300 ft. long, 3 arch spans, 250 ft. each; 24,000 cu. yds. conc., $625,000.

W. Va., Morgantown—H. C. Gilmore awarded contract for piers and abutments of curbstone for bridge over Cheat River, at Ice's Ferry, at $140,000; two 260, one 150 ft. spans.

Wis., Kenosha—Greiling Bros. Co., Green Bay, Wis., awarded contract for rein. conc. and bascule bridge in Main St., over harbor of city, at $380,000.

Prospective Work

ROADS AND STREETS.

Ariz., Tucson—$1,500,000 good roads bonds carried at recent election; Navajo County has voted $300,00 bonds for highway impvts.

Ark., Blytheville—Lake Street from the railroad to and through Highland place may be paved in early Spring, if not before. Most of the property owners have agreed to the impvt.

Cal., Bakersfield—Co. Supvrs. have authorized formation Rd. Impvt. Dists. Nos. 3, 4 and 5, in Midway-Fellows-McKittrick Dist., to constr. abt. 40 mi. paved highway. Paul E. Kressley, Newport Beach, will be engineer in charge.

Cal., Bridgeport—Cal. Hwy. Comn. plans to construct highway from here along slope of the Sierras for 400 miles, to connect roads from Los Angeles.

Cal., Calexico—Announcement made by officials of Mexicali that work will be started immediately on road from Mexicali to San Felipe, Lower California, 138 miles, by the Cantu administration.

Cal., Gridley—City plans to improve 30 blocks of new pavement on Gridley St. by curbing.

Cal., Los Angeles—Plan for dividing cost of constr. of harbor trunk hwy. has been suggested by the Bd. of Supvrs., as result of conference with city officials. Completion of road will cost $628,450, and will be divided as follows: Vernon, $42,000; Compton, $56,000; Wilmington, $71,500; between Vernon and Compton, $149,000; between Compton and Wilmington, $309,500. Two road impvt. districts will be formed.

Cal., Riverside—Co. Surv. Fulmor instructed by Supvrs. to prepare plans and specfs. for paving Corona end of Corona-Elsinore Hwy., for which $25,000 will be available. Bids will be taken on both conc. and oil macadam pavement. Plans will also be made for impvts. on rd. from Elsinore to Wildoma. Supvr. Smith authorized to proceed with impvt. of State St., south of Hemet, and also to start work on San Jacinto Ave. and 7th St.

Cal., San Diego—Co. Hwy. Comn. has submitted report to Supvrs. San Diego Co. recommending the constr. of 134.18 miles of paved roads, estimated to cost $2,300,000, to be provided for by a bond issue. Comn. recommends concrete paving. Col. Ed. Fletcher, Chrmn.

Cal., San Francisco—Following street work ordered: Grading, constr. of curbs, walks, catchbasins, sewers and asph. conc. paving on Arkansas St. between 22nd and a point 640 ft. southerly; similar work on Allison St., Brunswick to Norse Sts.; grading, constructing curbs and asphalt conc. pavement on Madrid St., Excelsior to Avalon Aves., and similar work as on Arkansas St., to Ulloa St., W. Portal Pk. tract to 15th Ave. Board Public Works requested to furnish est. of cost of improving Penn. St., 20th to 21st Sts.; St. Mary's Ave., Arlington to Chenery Sts., and Sloat Ave., Great Hwy., to 40th Ave., and from Great Hwy. to 19th Ave.

Cal., San Francisco—Following street work has been ordered: Impvt. on 27th, 28th, 29th, 30th, 31st, 32nd, 33rd and 34th streets between Taraval and Ulloa streets, by grading and constructing conc. curbs and several types of pavement.

Cal., Santa Monica—Ords. of intention to improve 9 streets in the Palisades district, involving total of $1,205,382 sq. ft. of paving, have been adopted by the City Comn., and bids will be asked in near future. Work consists of 2½-in. asph. conc. base with 1½-in. bithu. wearing surf. on Montana Ave. and San Vicente Blvd.; 2-in. bithu. paving on 6 other streets; also conc. curbs, rein. conc. lighting posts, conduits and appurts.; 24-in. double strength vitr. pipe strom drain; 36-in. and 42-in. radial interlocking brk. strom drain; 42-in. corrug. iron 12-gauge storm drain with wood protect. piles; jct. chambers, manholes, etc. Other dist. comprising 2nd St., Santa Monica Blvd. to Montana Ave., will involve 217,510.70 sq. ft. paving, 2½-in. asph. conc. base with 1½-in. bithu. wearing surf., curbs, lighting posts (rein. conc.), conduits, etc. John A. Morton, City Engineer.

Cal., Orange—City Engr. C. C. Bonbrake instructed to prepare plans and specfs. for paving North and South Glassell St. and North Tustin St.

Cal., Yuba City—Bd. of Supvrs. and Co. Engr. Edw. Von Geldern announce that an oil macadam type of road will be constructed in Sutter Co. under the $810,000 county bond issue recently voted.

Colo., Denver—State Hwy. Comn. and Commrs. Larimer Co. have agreed to expend $30,000 for impvt. of Loveland Canon Rd., Loveland to Estes Pk.

Colo., Denver—Bureau of Pub. Rds., U. S. Dept. of Agriculture, 301 Custom House, Denver, will receive bids in March, 1920, for constr. of the Berthoud Pass road project, located within the Pike and Arapahoe National Forests, Clear Creek and Grand Counties.

Colo., Denver—Mt. Evans Hwy. may be extended to top of peak. Est. cost, $46,000. J. E. Moloney, Chf. State Engr.

Colo., Gunnison—Extensive road plans announced for 1920. Survs., R. B. Sims and John Burgess (Denver office of Forestry Serv.) have completed survey of proposed road to Taylor River canyon. Road will cost $15,000.

Conn., Hamden—Town contemplates paving State St., Dixwell and Whitney Aves.,

asph. and concrete. About $100,000. G. M. Warner, Highwood, 1st Selectman.

Fla., Key West—City considering paving 100 blocks of streets; will vote on $100,000 bond issue.

Fla., Live Oak—$700,000 bonds voted by Suwanee County for highways and lateral roads.

Fla., Okeechobee—Okeechobee Co. Commissioners will co-operate with State Hwy. Dept. in constr. of main cross state hwy., Arcadia to E. Coast; $210,000 appropriation made out of proceeds of recent bond issue. Road will be of brick constr. Wm. F. Cocke, Commr., Tallahasse, Fla. Commrs. of this county will also constr. sys. of roads through county, connecting Fort Drum, Bassinger and other points.

Ga., Albany—$81,000 bonds voted by citizens for extensive street paving program.

Ga., Augusta—$650,000 to be expended for paving streets in city.

Idaho, Orifino—Clearwater Highway Dist. voted $300,000 for hwy. improvements in districts of Greer, Weippe, Lolo, Elk River, Frazer, etc.

Ill., Ashkum—Resolution adopted by Bd. Local Impvts. to improve 21 blocks of streets by paving in village.

Ill., Bloomington—Board approved plans and estimate of $18,000 for proposed East Lincoln St. improvement.

Ill., Chicago—City contemplates following street improvements: Wabash Ave., 12th to 22nd streets (creosote blks.); So. Kilbourn Ave., 16th to 22nd streets (brk.). est. cost $60,000; Addison St., Cicero to Long Aves. (asph.), $74,000. Bd. Local Impvts. will meet to consider whether these impvts. can be completed this year.

Ill., Chicago—Board Local Impvts. has ordered the widening of Western Ave. to 100 ft. by setting back the building line on both sides of street. Plans approved after public hearing, at which 1,100 property owners were represented. Avenue is 23½ miles long.

Ill., Chicago Heights—Co. Commr. D. D. Pierson has succeeded in having Halsted St., Joe Orr Rd. south to 14th, included under the state-aid roads which are to be built out of the sixty million dollar bond issue.

Ill., Kankakee—Proceedings started for building important pavements. One provides for brick paving on Indiana Ave., Merchant to Station Sts.; the other for paving alley in rear of Elk's club house, south of Indiana Ave., between Court and Merchants Sts.

Ill., Pekin—$5,000 will be appropriated by Pekin Twp. for assisting in paving of grade road on west side of river. City of Pekin also has appropriated like amount, citizens have pledged about $20,000, and balance will be paid by State Hwy. Dept. Amount of roadway to be paved is nearly 2 miles in length. Peoria County has pledged $5,000.

Ill., Rockford—City plan proposes a Keith Creek Parkway. Myron H. West, who made survey, suggests that all the land along Keith Creek from Rock River as far as 10th Ave. be taken over, the boulevarding of 10th Ave. and 9th St. to 6th Ave., and taking over the blocks lying between 6th and 7th Aves. from this point east to city limits.

Ill., Rockford—Camlin Ave. and Douglas St. will be improved; concrete paving to be laid.

Ill., Rockford—Both the Grant highway, Rockford to west line of Winnebago County and Beloit Rd., north end of present conc. roadway in Harlem to Roscoe, will be constructed next year. Engrs. and Surveyors at work on the highway west of Rockford.

Ill., Springfield—Work on the Cannon Ball trail between Burlington and Peoria or possibly De Pue, will be started early in 1920.

Ind., Indianapolis—Bd. of Public Works confirmed resolution for resurfacing North St., Fort Wayne Ave. to Mass. Ave. Petitions for impvt. of Capital Ave., McCarty St. to Morris St., and Cable St., Michigan St. to 2nd alley north, referred to City Engr. for his recommendations.

Ia., Des Moines—Thirty-three counties have voted 2,000 mi. hard surf. roads to be built in 1920. In 36 counties projects have been approved for 976 miles perm. grading, 35 miles grading and 135 miles hard surf.

Kans, Anthony—Plans being prepared by C. C. Eastham, Engr., Anthony, for paving 10 blocks N. and S. Kansas, S. Bluff and N. Franklin Sts.

Kans., Emporia—Final plans for paving New Santa Fe Trail on 1st sect. of 4½ mi. west of here. completed and sent to Topeka for approval. All suggested corrections on plans have been made and no delay is expected.

Kans., Fredonia—City preparing to put in 17 blocks gravel macadam, concrete and brick pavement; also conc. curb and gutter.

Kans., Manhattan—City making plans to put in $200,000 of asph. conc. paving on streets early in Spring. A. J. Rhodess, City Engr.

Ky., Prestonburg—Floyd County Commrs. will construct Old Dominion Hwy.; $200,000 bonds voted.

La., Donaldsonville — Road to Gibson through six parishes may be constructed. $100,000. H. S. Smith, Thibodaux, La., interested in the impvt.

La., Rayville—$1,000,000 bonds voted by Richland Parish; $200,000 Fed. aid.

Md., Hagerston—City considering constr. of 1½ mile blvd., from Virginia avenue to Antietam creek, 100 ft. wide.

Mass., Boston—Commr. of Public Works states it is his intention to resurface with bitum. macadam Hall street, South street to Call street, est. cost for labor and materials, $2,200; lay granite blk paving, grout joints in Gerard street, Norfolk to George, est. cost, $2,500; resurface with macadam Wood avenue, Oakland street to River street, $4,000.

Mich., Adrian—Petitions for hard road—Medina to Seneca—granted by commission and preliminary survey ordered made by County Engr.; also, estimate of cost.

Mich., Benton Harbor — County Rd. Commrs. voted to improve more county roads and also adopted resolution to make Niles-Summerville Rd., Niles Twp., a county road.

Mich., Detroit—It has been decided to pave the Eight-Mile Road, in conjunction with Oakland and Macomb counties and state hwy. department; Telegraph Road, Michigan avenue to Flat Rock, will also be paved. This is a distance of 14 miles.

Mich., Ludington—Mason County Hwy. constr. program for 1920 calls for 15 miles

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trunk lines. Supvrs. have voted $67,000 for the work.

Mich., Monroe—Several streets will be improved here. $30,000 bonds voted for the work.

Mich., Petoskey—Emmett County has voted $400,000 bonds for good roads.

Minn., Duluth—Rotary Club has petitioned City and Co. Commrs. to make Lake Shore Drive a blvd., and part of Babcock system. E. J. Filliatrault, Pres.

Minn., E. Grand Fork—City contemplates constr. of asph. or conc. road in Dist. No. 1. Est. cost about $250,000. A. Briggs, Clk.

Minn., Moorehead—Approx. $1,000,000 will be expended for municipal improvements here next year (large proportion of city work having been started). Plans prepared for 32 blocks paving.

Mo., Cassville—$30,000 bonds voted for road construction in Flat Creek Twp.: Crocker, $400,000 road bonds voted at special election in Phelps County; Carthage, city voted $150,000 bonds for paving streets; Springfield, Conway Road Dist. will issue bonds to amt. of 14,000 as result of special election.

Mo., Fredericktown — Madison County Commrs. will construct 50 miles of state highways—St. Francis Co. line to Wayne Co.—at estimated cost of $455,000; also, 250 miles of turnpike.

Mo., Houston—Texas County will construct 64 miles of roads. C. L. Johnson, Co. Judge. H. P. Moberly, Div. Engr., Springfield, Mo.

Mo., Jefferson City—State Hwy. Board approves applications for 96.56 mi. gravel & conc. rd., $1,039,214. Impvts. located in Centry, Jackson, Marion, Lawrence, Butler, Lewis and Jasper Counties.

Mo., Joplin—City Council approves following proposed work: Paving with conc., F street from Main street to Jackson avenue (8 blocks), at cost of $12,172; Indiana avenue, 15th to 20th streets, with class G macadam (5 blks.), at cost of $3,373; Maiden Lane, A street to Perkins avenue, with class F macadam (3 blks.), at $1,889, total $17,435.

Mo., Neosha—$500,000 road bonds voted to build concrete roads. This District (Joplin Special Road Dist.) includes nearly all Shoal Creek and part of Five Mile Twp., in Newton Co.

Mo., Palmyra—Marion County Commrs. contemplate graveling road from Hannibal to Perry, at cost of $125,000. B. F. Smith, Co. Hwy. Engr.

Mo., St. Joseph—State Hwy. Bd. has approved St. Joseph-Atchison Hwy. and $409,330 will be available for constr. of this road.

Mo., St. Louis—City considering widening of the main streets and constr. of a blvd. system. Four propositions contemplated: Widening of Olive street, 12th street to Channing avenue, which will cost, according to present plans, abt. $2,000,000; Palm street, Florrisant avenue to Mallinckrodt street, with a continuation to city limits on Natural Bridge Road; widening of Gravois avenue, 12th street and of Kingshighway and Bircher Road to Partridge avenue. Total est. cost of work, $4,150,000.

Mo., Wheaton—$25,000 bonds voted to construct state road through town.

Mont., Billings—$200,000 bonds authorized for fed. aid projects and $50,000 for dirt roads in Yellowstone County. C. E. Durland, Co. Surv.

Mont., Helena — 29 Montana Counties have authorized expendt. of $5,380,000 for hwy. constr. 5 other counties have previously voted $875,000, making a total of $6,255,000 available for good roads. Almost all of this money will be expended under fed. aid plan which provides state and govt. will each pay half of the cost of the project. Government has appropriated $5,500,000 for this work in Montana.

Neb., Chadron—Present plans call for paving two principal streets.

N. J., Trenton—Proposition being considered to construct the Assunpink Way. Est. cost, $1,000,000.

N. M., Sante Fe—State Hwy. Dept. approved project involving 17 miles of road from Farmington to Aztec in San Juan Co., to cost $51,621; Secy. of Agriculture has approved the following projects: 15 mi. of hwy., Portales to Clovis, $123,475; 15 mi., Curry Co. line via Clovis to Texico, $122,353.

O., Akron—According to statistics compiled by the B. F. Goodrich Rubber Co., following states have approved their highway bond issues: Arizona, $4,200,000; Arkansas, $50,000,000; California, $40,000,000; Illinois, $60,000,000; Maine, $10,000,000; Michigan, $50,000,000; Nevada, $1,000,000; New Mexico, $5,000,000; Oregon, $10,000,000; Pennsylvania, $50,000,000; Wyoming, $2,800,000—total $283,000,000. Following states will vote on highway bonds as follows: Ala., $5,000,000; Colo., $5,000,000; Georgia, $40,000,000; Kans., $60,000,000; Minn., $100,000,000; Miss., $20,000,000; Mo., $60,000,000; Mont., $15,000,000; N. C., $25,000,000; N. D., $25,000,000; S. C., $25,000,000; Tenn., $50,000,000; Tex., $75,000,000; Utah, $4,000,000; Wash., $30,000,000; W. Va., $50,000,000; Wis., $50,000,000—total $664,000,000.

O., Cincinnati—County roads on which bids will soon be asked by Commrs. are as follows: Cincinnati & Louisville Road, $226,000; Sect. A, Harrison pike, $159,000; Sect. B, Harrison pike, $103,000. State will pay $200,000 of total est. cost.

O., Van Wert—Co. Commrs. will expend nearly $10,000 for placing crush. stone on E. Sycamore, N. Wayne and Frothingham streets. Stone will be 10 ins. thick and 12 ft. wide on these streets; Commrs. have made application to State Hwy. Comn. for state aid in improving 5½ mi. Lincoln Hwy.

Okla., Collinsville—Addtional paving districts being formed and it is expected there will be at least 15,000 sq. yds. paving, procedure for which will be started within near future. Approx. cost, $75,000. Johnson & Benham, Conslt. Engrs., 8th Flr., Firestone Bldg., Kansas City, Mo.

Okla., Cushing—City contemplates 40 blocks of paving. Clarence A. Wood, Engr., Stillwater, Okla. S. P. Alles, Mayor.

Okla., Enid—$250,000 will be expended on hard surface roads in Garfield County. County Excise Bd. has agreed to add to this sum $50,000 to be used on good road constr.

Okla., Sapulpa—$1,000,000 bonds voted for good roads.

Okla., Wilson—Prelim. steps taken at council meeting to insure paving entire business section of city (abt. 15 blks.).

Ore., Astoria—Resolution adopted by council to pave, grade & constr. walks on portions of Floral avenue, 24 ft. wide, conc.; grading & paving portion of 14th street, Exchange street, 13th street and Duane street. Cbst of work will exceed $20,000. E. G. Gearhart, City. Aud.

Ore., Forest City—Ord. passed by council to drain, curb and pave Main street; also, 4th avenue, 3rd to A streets. Cost will exceed $10,000. W. P. Dyke, City Recorder.

Ore., Marshfield — Contracts for street work will be let this winter and constr. started as soon as weather permits. Street Comm. instructed to report on streets needing improvement.

Ore., Portland—Multnomah County budget for 1920, as tentatively prepared by Road Dept., calls for total appropriation of $1,200,000. Largest amt. asked for is impvt. of Fairmont Blvd., at $166,500; next to this impvt. of St. Johns Road, $165,000. New rd. up Marquam Gulch to new county hospital, is estimated at $159,750. Other large projects are: Montgomery Dr., $67,200; Boones Ferry, $150,000; Columbia Blvd., $75,970; Base Line Extension, $47,840.

Ore., Roseburg—City Engr. instructed to prepare plans & specfs. for paving Spruce and Washington streets.

S. D., Britton—Engrs. of State Hwy. Comn. are making survey of road—Britton to Sisseton—on which some work will be done this fall.

S. D., Sioux Falls—Resolutions for more than 175,000 yds. of paving to be done next year has been passed by Board City Commrs. S. B. Howe, City Engr. This means that between nine and ten miles of streets will be surfaced here next year, provided labor and materials can be obtained.

Tenn., Chattanooga—It is planned to construct conc. road extending from point of ridge near Lakeview to heights of Delonges point at an expendt. of $290,000. Proj. urged by Chattanooga Auto Club and Missionary Ridge Business League.

Tenn., Nashville—Over $10,000,000 now available, through bond issues, in various counties. Surveys being made in 19 counties and 13 additional road projects have been approved. V. P. Moore, Chf. Engr., State Hwy. Dept.

Tenn., Nashville—$180,000 bonds voted for widening and paving streets and alleys.

Tenn., Somerville—$500,000 bonds for good roads voted by Fayette Co. State and Fed. aid, $1,000,000.

Tex., Abilene—Co. Commrs. have decided to gravel several miles of pike betw. Abilene and Buffalo Gap, giving continuous connection through the Gap for Hwy. No. 7. Est. cost about $10,000.

Tex., Dallas—Geo. Fairtrace, City Engr., making plans for an extensive paving program in So. Dallas. Wall street, Forest avenue, Peabody, S. Lamar, Grand avenue, Cleveland, Alma and Crockrell streets scheduled to be improved.

Tex., E. Dallas—Chalk Hill, the steepest climb on Dallas-Ft. Worth Rd., will be reduced in grade from 7 to 6 per cent., at cost of $38,800.

Tex., Ranger—$1,000,000 bonds issued for improving streets by paving and other public improvements.

Tex., San Antonio—Petitions from property owners on 31 streets and avenues, asking for paving, were filed with the City Comn. Petition referred to Commrs. L. Heuermann, in charge of street and pub. impvts.

Tex., San Antonio—Bexar Co. will share in cost of improving E. Houston St. in order to provide paved hwy. as outlet from St. Hedwig Rd. to center of city.

Va., Altavista—Resolutions adopted by Otto River Good Roads Club approving bond issues by roads as follows: 18½ mi. from here to Brookville line; 4 mi. rd., Evingston to Bedford Co. line; 3 mi. from Evingston to Rehobeth Church; 3½ mi., Lynch Sta. to mouth of Bishop's Creek; 7 mi., Altavista to Leesville and to brdg. over Goose Creek; 1 mi. from Leesville to Bedford.

Wash., Seattle—Engr. Humes of King County desires that plans be completed without interruption on following projects so that bids can be called in early spring: Redmond-Hollywood paving; Auburn-Black Diamond Hwy. link paving; 2 mi. Richmond Beach-Richmond Highlands link paving; Shanahan Rd.-Vashom Isln., 1.1 mi., $16,500; Dockton Rd.-Vashom Island, 1.8 mi., $27,000; C. O. Qualheim No. 1 Road, 1.1 mi., $13,200; Burien Way, 1.6 miles Selleck Hot Springs Rd., 22.1 mi., $221,100; Palmer Junction-Kanaskat Rd., 1.1 mi., $16,500; Franklin Dept. Rd., 0.5 mi., $8,000; R. A. Ballinger Rd., 3.3 mi., $44,550; C. T. Conover No. 2 Rd., 2.1 mi., $29,200; Pacific Hwy. to Sound, 4.5 mi., $75,000; Duval Flat Rd., 0.9 mi., long trestle included, $35,000; Solberg Rd., 6.1 mi., $91,000; Renton-Maple Valley Rd., 6.1 mi., $73,200; Wm. Calvert Jr. extension rd., 1.3 mi., $16,900.

Wis., Beloit—City will let contracts early in 1920 for following street work: Central, Chapin, Clary, College, Elm, Eight, E. Grand, Laurence, Merrill, Hillcrest, Middle, Partridge, Portland, Strong, Woodward, Sherwood drive, Hillcrest to city limits, Park Pl., Hackett. Choice of asph. conc., sheet asph. brik & conc., all conc. base. Abt. 5 miles of paving. Approx. cost, $200,000. G. E. Heebink, City Engr., Beloit.

SEWERAGE AND SEWAGE TREATMENT

Cal., Fresno—Resolution to constr. 8, 10, 12, 16, 18 and 20-in. cement pipe sewers in No. Fresno Dist. has been adopted by council.

Cal., Los Angeles—City Council has instructed Pub. Wks. Comn. to take up seriously question of constructing W. Jefferson street storm drain. Est cost, $3,000,000; also the Arroyo de la Sacatella storm drain. Est. cost, $2,000,000. City Engr. says city has already spent $570,000 on these two projects and is preparing plans for 5 more storm drains.

Cal., Modesto—City will vote on issuing $15,000 bonds for sanitary sewers, $75,000 bonds for storm sewers and $30,000 bonds for septic tank and filter beds.

Cal., Turlock—City trustees have decided to call election for purpose of voting on $60,000 bonds for extensions to sewer system.

Fla., Miami—$60,000 bonds voted for sewer system extension and connections.

Ga., Calhoun—$35,000 voted for sewer, water works and street impvts. A. R. McDaniel, Mayor.

Ga., Cartersville—City officials have definitely decided that city shall build its own sewerage system. Steps taken to begin work at once.

Ill., Belleville—Ord. passed by City Council to construct sewer in 38th street, Main street to Summitt avenue. Est. cost, $2,025.

Ill., Decatur—Plans for sewerage installation here, have been submitted for approval of state dept. of public health at Springfield, by Pearce & Greeley, consulting engineers, Chicago. Plans provide for intercepting sewer into which all sewage of city will flow and be conveyed to treatment plant. Design for treatment wks. not yet decided upon. Two methods being considered, namely, areation in presence of activated sludge and treat. by so-called percolating filters.

Ill., Fairbury—Town has retained Miller, Solbrook & Warren Co., Decatur, Ill., to make plans and specfs. for sewerage project which will cost abt. $100,000. Abt. 10 miles sewer pipe will be laid. It is intention to let contract this winter so work can begin early in spring. Engrs. will plan for double system of sewerage; one for ordinary wastes and the other for storm water.

Ill., Nokomis—Town contemplates constr. of sewer system, consisting of main sewer, lateral branches, manholes, "Y" branches for house connections, settling tank, sludge bed and necessary connections and appurts. Est. cost, $43,044. A. H. Bartlett, Clk of Montgomery County, Hillsboro, Ill.

Ill., McHenry—City considering installation of sewer system; about 47,000 lin. ft.

Ill., Morton—Storm sewer system will be installed in village in near future.

Ind., Huntington — Chas. Brossman, Consit. Engr., Indianapolis, retained by city to prepare plans, specfs. and estimates for proposed sanitary sewer system. Plans to be completed this fall so constr. can start early in spring.

Ind., Anderson—Petition filed with City Clk. Essington for sewer from 23rd street on Delaware street to 27th street and along 24th street from Delaware to Brown streets.

Ind., Seymour—City considering installation of sewer system. B. E. Jenkins, Expert Engineer, recommends that survey be made and completed this winter so that work on proposed system could be started in spring.

Ia., Corwith—Town considering installing sewerage system.

Ia., Des Moines—Contract for constr. of the Northwest Sewer System will probably be let within the next six weeks. Total length is abt. 19 mi., and est cost, $212.-058.78, of which $21,140 will be spent for manholes alone, and $1,500 for pumping plant at E. 21st street and Easton blvd. Two small systems being planned to operate through temporary septic tanks, and are to be connected with the S. West system when completed. Will cost abt. $25,000. Next system contemplated is an intercepting sewer along the west side of the Des Moines river. Carl Kastberg, City Engr.

Ia., Ottumwa—Bids will soon be asked for sewerage system improvements and disposal plant. Plans in progress. Est. cost, $26,000. Jas. V. Curran, Clk.

Ia., Oxford Junction—Town will construct sanitary sewer system. At special meeting citizens voted in favor of impvt.

Ia., Pierson—Town having preliminary survey made with view to constructing modern sewerage system.

Ia., Sumner—Council has instructed City Engr. to draw plans for new sewage disposal plant. Est. cost, $25,000.

Kans., Chanute—Plans and specfs. for sewers in southwest section of city have been approved. Plans call for extension of main sewer No. 2 and also for extension of laterals Nos. 203 and 204.

Kans., Hutchinson—Resolution accepted by City Comn. for constr. of sanitary sewer beginning at south side 21st street, west in alley to Monroe street, south side of 23rd, and extending east in alley to manhole in Plum street.

Md., Aberdeen—Town contemplates construction of sewer system. $25,000. Norton, Bird & Whitman, Engrs., Munsey Bldg., Baltimore.

Mass., Boston—Commr. Pub. Wks. states that it is his intention to construct conc. conduit 5 ft. 3 ins. in diam. in Tenean street and in private land abt 185 ft. northwest of Fulton street, in Dorchester Dist. Est. cost, $6,400; also, conc. conduit for surf. water 17 ft. by 13 ft. 9 ins. for impvt. of Stony Brook from 122 ft. south of Washington street at Franklin Pl. to Toll Gate Rd., W. Roxbury Dist. Est. cost, $136,000.

Mass., Boston—Commr. of Public Works states that it is his intention to construct san. sewer 10-in. earthen pipe in Huntington avenue, betw. Thatcher street and Safford street, Hyde Park Dist., at est. cost of $1,730; 10-in earthen pipe in Thatcher street, Bradlee street to Metropolitan avenue, Hyde Park Dist., $2,850; sanitary sewer 15-in. by 10-in. earthen pipe in Bradlee street, 240 ft. north of Collins street and Thatcher street, Hyde Park Dist., at $8.835.

Mass., Boston—Commr. Public Works states that it his intention to construct san. sewer 12-in. earthen pipe in Kennebec street, Oakland street to Roanoke Rd., in Hyde Park and Dorchester Districts. Est. cost, $6,461; also, 12-in. earthen pipe in strip of land betw. Roanoke road and Ruskin road, and in Ruskin road, 240 ft. easterly of Wood avenue and abt. 300 ft. southeasterly, in Hyde Park Dist. Est. cost, $4,166. Approved by the mayor.

Mich., Benton Harbor—Council voted in favor of sewer constr. east of the Edwards avenue viaduct; property owners have petitioned for lateral sewers on John, LaSalle, Madison, Winans, Waukonda, Forest, Edgcumbe, Waceda and Pasadena streets. Sewer will also be built on section of Colfax street.

Mich., Muskegon—Specfs. and estimates will soon be completed for the big sewer on Western avenue. This was included in campaign for $145,000 bond issue adopted last spring. Sewer will necessitate tearing up of Western avenue pavement.

Mich., Port Huron—Resolution adopted by Comn. to construct lateral sewer in Oak street, 20th to 24th streets.

Minn., Chisholm—City considering construction of sewage disposal system. W. Drew, Dept. Record. Private plans.

Minn., Elmore—Ord. passed for laying out and constructing sanitary sewer within village limits.

Minn., Faribault—City considering construction of lateral sewer; private plans; 4 blks. of tile. E. W. Johnson, City Clk.

Minn., Luverne—$24,000 bonds voted for sewers. Jno. Bauer, Clk.

Minn., Redwood Falls—City will construct sewers and pave this fall. Engr. L. P. Wolff, 1000 Guard. Life Bldg., St. Paul; H. C. Rutter, City Clerk.

Minn., St. Cloud—City will construct sewers in Wright and Benson subdivision, E. St. Cloud, Impvt. Dist. No. 372. A. W. Buckman, City Clk.

Minn., Warren—City will pave and construct sewers in about 20 blocks. Engr. L. P. Wolff, 1000 Guard. Life Bldg., St. Paul; J. R. Maeseth, City Clk.

Minn., Wells—City will construct storm and sanitary sewers; bids before winter. Engr. L. P. Wolff, St. Paul; G. G. Busche, Vil. Recorder.

Miss., Louise—City—J. L. Corn, Mayor—contemplates issuing bonds for construction of sewer system.

Miss., Starkville—$55,000 bonds voted for sewer, water and electric light systems.

Mo., Boonville—Ord. passed by Council authorizing constr. of sewer main in West Boonville. $11,000 bonds voted for the work last summer. Council also asked bids for the work.

Mo., Harrisonville—Town contemplates constr. of sewer system.

Mo., Joplin—Village Heights and So. Joplin will have sanitary sewer for which they have appealed. O. P. Mahoney, City Commr. of Sts. instructed to obtained information regarding cost of survey, plans, etc., for proposed sewers.

Mo., Joplin—City Comn. has approved proposal submitted by Dr. R. B. Tyler, Commr. of Health, to enlarge, repair and extend city system of sewers at cost est. at $200,000 to $500,000.

Mo., Mexico—City considering calling election to vote on $25,000 bonds for sewage disposal plant.

Mont., Anaconda—City considering san. sewer system. Est., $12,000.

Mont., Billings—$400,000 bonds carried at election for storm sewers.

Mont., Park City—City considering installing sewers in various streets. About $20,000. P. Hastings, Billings, Engr.

Neb., Alliance—City considering constr. of storm sewers in Dist. No. 1. Est. cost, $4,472.

Neb., Alliance—City will build sanitary sewers in Sewer Dist. No. 38. Grace I. Kennedy, Clk.

Neb., Cedar Rapids—Engineer employed to draw up plans and specfs. for sanitary sewer system here.

Neb., Franklin—City plans to construct complete sewerage system, est. cost of main sewers, $19.320; lateral sewers, $32,655. W. A. Butler, Clk.

Neb., Scribner—Town Bd. has decided to install sewer system, $45,000.

Neb., Nebraska City—Ord. passed providing for special election to vote on $52,-487 bond issue for purpose of constructing sys. of sewerage for city on south side.

Neb., Ord—Town will have sewer system if plans of city administration are carried out. Council has studied matter carefully and decided the main sewers should be laid before any paving is done. Plans being made to go ahead with the work as soon as possible. Proposed sewer will start from river n. e. of town and will be 48 ins. in size to start with, dimishing as it comes this way; present plans being for main sewer to so. east part of town and to n. w. part, with an off-set stem to the square. Parts where proposed paving will go are to be sewered first. Est. cost of work provided for is $98,000.

Neb., Ulysses—Plans under way to extend present sewer system west on C street to corp. limits. Survey of project completed and est. of cost prepared.

N. J., No. Bergen—City having plans prepared by R. Gaw, Engr., W. Hoboken, for sewer in Paterson Turnpike. About $40,000.

N. Y., Flushing—Boro. Pres. Connolly will request Board of Est. to grant $4,-000,000 for new sewers to drain Woodside, Winfield and Jackson Heights Sects. Chf. Engr. Tait and his asst. engrs. have about completed the plans.

N. C., Elizabeth City—City contemplates installing complete sewerage system. New state sanitary law goes into effect this month, but it is believed if work toward complete system for city can be got under way state authorities will extend time to such length as may be necessary to enable city to complete the system.

O., Cleveland—$400,000 will be expended on the E. 140th street sewage disposal plant, which will be placed under contract

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this fall, according to report of Sanitary Engr. Cascoigne. These contracts will permit screening and disinfecting the sewage. Settling tanks to complete the plant will not be installed until further bond issue is available.

O., Middleton—There still remains $20,000 worth of sewer impvts. to be let in 1919. Ord. passed authorizing issue of bonds. Work on the 14 new sewers within central portion of city will not begin before spring, as it will be necessary to advertise for bids, both for sale of bonds and work of construction.

O., Ravenna—Resolution adopted declaring it necessary to build 10 incompleted sections of sanitary sewer. Est. cost, $14,000.

Okla., Ada—Plans and specfs. under way for constr. of new sewage disposal plant; also system of storm sewers for which bonds in amt. of $75,000 were voted recently. Bids will probably be received abt. the middle of November. Johnson & Denham, Consit. Engrs., Firestone Bldg., Kansas City, Mo.

Okla., Yukon—Plans being drawn up by Co. Engr's. office for extending present sewer system. Co. Engr. H. G. Powell.

Pa., Erie—City Engr. Lynch has completed plans for bldg. sewer to carry the water of Cascade creek—2nd street to bay front. Ord. introduced to constr. 9-in. sanitary tile sewer in Schley street—north line of 20th street northwardly 227 ft.

Pa., Franklin—City will construct sewage disposal plant, Elk street, $200,000. Morris Knowles, Jones Law Bldg., Pittsburgh, Pa., Consit. Engr. Prelim. survey.

Tex., San Antonio—City will construct 64 miles of sewers reaching practically all unserved districts of city. $500,000 bond issue recently authorized. Impvts. will include parts of nearly 600 residence streets Charleston, W. Va.

W. Va., Charleston—City Engr. Ernest Bruce planning to build 65 sewers. $1,000,000 bonds voted.

W. Va., Warwood—$150,000 bonds voted for sewer and street impvts.

Wis., Eau Claire—$75,000 bonds voted by city for construction of sewer system; trunk lines in outlying districts.

WATER SUPPLY AND PURIFICATION

Ariz., Nogales—Election will be called to vote on $37,000 bond issue for pumping units for water dept., $15,000 to repair and enlarge reservoir and $135,000 to lay 14-in. steel pipe line from pumping plant to the reservoir.

Ark., Conway—City will replace 1½ mi. wood water main with cast iron pipe. $15,000.

Cal., Avalon—$50,000 will be expended by city (Catalina Island) for increasing water supply, adding generating unit to electric lighting plant and bldg. new gas plant.

Cal., Lancaster—$30,250 bonds voted by Los Angeles Co. Water Dist. No. 4. for purpose of bldg. 75,000-gal. steel tank on steel tower, pipe lines, pumping plant, wells and distributing system. A. M. McPherrin, Clk. of Board of Supvrs.

Cal., Los Banos—City Trustees have started proceedings to vote $36,000 bonds for purchase of existing water system and $67,000 bonds to complete same and provide fire fighting apparatus.

Cal., Sacramento—Board Pub. Wks. have purchased site for filtration plant here. Frank C. Miller, City Engr.

Cal., San Diego—Election soon for issuing bonds for following impvts.: Improving water transmission and distributing lines and bldg. Barrett dam, at $1,000,000; $200,000 for impvt. and repair of pipe line and distributing system; $80,000 for paving Tide street for distance of 8,800 ft.

Cal., Whittier—J. B. Lippincott, Consit Engr., Central Bldg., Los Angeles, retained by City Trustees to prepare plans for and supervise constr. of the proposed extension to city water system, for which $361,000 bonds were voted.

Fla., Fort Lauderdale—City considering water works extension. $35,000, softening plant; daily capacity 250,000-gals.; 1½-mi. extension of mains. Geo. A. Main, Engr.; Geo. W. Hall, City Clerk.

Ill., Bloomington—Board of Local Impvts. approved plans and estimates for McClun street water main. New main will extend from Washington to Bell street and constitute the main water artery to the southeastern section of the city. Est. cost of the 10-in. main is $11,469.

Ill., Chicago—Plans for rehabilitation of municipal water works system on basis of city's needs in 1955, providing for water supply for 10,000,000 population, will be completed in a month by City Engr. P. C. Coombs. New pumping stations, one addl. crib & intake, number of large connecting tunnels, standardization of all pump'g. stas., included in plans which call for expendt. of $35,000,000. Included in the plans is pumping sta. to be built at W. 43rd St. and Western Ave., at cost of $3,165,000, which will be largest pump'g sta. in world. Wk. on tunnels will begin in abt. 10 days. Plans also include increased capacities at the 68th St., Springfield Ave. and Central Pk. pumping stations and for installation of more efficient engines & pumps at various stas., as present apparatus is worn out. Plans have tentative approval of Commr. of Pub. Wks., C. R. Francis.

Ill., Jacksonville—$210,000 bonds voted to pay off floating indebtedness and construct filtration plant; also remodel light plant.

Ill., Kewanee—Village of Wethersfield is desirous of obtaining a more adequate water supply. Plans being considered of securing a water supply from Kewanee. Although no engineering has been done on the proposition, it has been suggested that a main be laid to Wethersfield in the form of a loop; that is, abt. 2,000 ft. down Willard St. and abt. 2,000 ft. down Tenney St., the two being joined by a line across McClire St.—distance of abt. 600 ft.

Ill., Oak Park—If plans of Geo. H. Graves, Supt. Water Dept., are carried out the water supply and pressure of village will be improved. Oak Pk. now has 16-in. main from Chicago to pumping sta. at Lombard & Lake. Mr. Graves proposes another large main. Village Board considering the proposition.

Ill., Pana—Town will issue $20,000 bonds at once and let contract for constr. of a filtration plant at the city reservoir. It is planned to have plant built this Fall.

Ill., Wheaton—Ord. passed by Council for extension of city water on Harrison, Forest Aves., Washington, Cross, Lexington and Scott Streets.

Kans., Burns—City having plans prepared by F. E. Devlin, Engr., El Dorado, for bldg. new water works system. Abt. $27,500.

Kans., Ottawa—Town planning to expend $23,600, according to ests. of engineers, on impvts. to water works system. Important features of the plan to conserve supply in dry periods, are new dam to cost $14,570 and raising of height of present dam at expendt. of $8,100.

Kans., Paola—City Engr. instructed to prepare plans and specfs. of cost of repairing and improving water works system, and installing filtr. plant. C. E. Liebengood, City Clk.

La., Bogalusa—$525,000 bonds voted for various improvements. Included is $125,000 for water and sewers.

Md., Elkton—Town Commrs. considering installation of filtration plant enlarging mains. $80,000 bonds. Levi J. Houston, Jr., Engr., Fredericksburg, Va. Wm. H. Mackall, Pres. of Commission.

Mich., Houghton—Water supply proj. involving expendt. of $20,000 is proposed by Mayor Farries. Plan will involve erection of new dam at cost of abt. $20,000. Reservoir of abt. 500,000-gal. capy. will also be constructed.

Mich., Saginaw—Extensive impvts. to water system contemplated. Committee of citizens studying problem of new source of water supply; also new consolidated pumping station to take place of two old ones. R. F. Johnson, City Commr. expects to put in some 25 miles of mains—about half distribution and half force mains—during 1920. Hazen. Whipple & Fuller, Consit. Engrs., New York.

Minn., Duluth—City Commrs., will install pump at Lakewood Pumping Sta. next year. Est. cost $40,000; will soon ask bids on extension of water and gas mains in Cooke St., 48th Ave. E. to Superior St.; also on rebldg. reservoir at 15th Ave., E. and 8th St., rein. conc. at $50,000, also on relaying duplicate water mains bet. 34th Ave., E. and Lakewood. P. G. Phillips, Commr.

Mo., Joplin—Burns & McDonnell, Engrs. retained by City Comnm. to prepare estimate for new water works system for city.

N. C., Charlotte—Charlotte Consolidated Constr. Co., will lay water and sewer lines on portion of E. Kingston, E. Avondale Aves., Dilworth—980 and 460 ft., respectively.

N. C., Shulls Mills—Boone Blowing Rock Light & Power Co. organized; Mr. Whiting, Mgr.; 340 H. P. hydro-electric plant on Boone Fork, branch of Watauga River; $60,000; rein. conc. dam, 14x130 ft.; 1600 ft. 30-in. steel pipe; conc. and steel power house; horizontal wheel and generator; 3 transmission lines. David R. Shearer, Engr.

Neb., Venango—Plans & specfs. for light and water systems for town have been completed by Hennessey Engineering Co., Omaha.

N. J. Montclair—Town Bd. Commrs. will make application to state for acquisition of Split Rock Pond, Morris Co., and the diversion of that water to Montclair.

O., Canton—City contemplates increasing its water supply from 5,000,000-gals. per day to 15,000,000-gals. (obtained from Dan Smith farm n. e. of city).

O., Niles—Ord. passed requiring all users of water as furnished by the municipal Water Wks., to install water meters. Homas Thomas, City Clk.

O., Ravenna—Ord. passed approving revised plans of Serv. Direct. A. S. Herbig, for constr. of diversion dam and completion of gravity conduit line; also open ditch for extension and impvt. of water works sys.

O., Springfield—Supt. Geo. Cotter preparing data on extensions of water mains to be started this Fall. The water mains in So. Limestone Street will be put in good condition before paving is started.

O., Toledo—Ord. passed authorizing Director Pub. Serv. to enter into contract for furnishing and installing, in connection with the boiler plant in Broadway Pumping Sta., Div. of Water, certain auxiliary equipt. as follows: An evaporating sys., 1 open feed water heater equipped with metering device, an automatically controlled balanced draft outfit for each boiler; 2 automatic carbon dioxide recorders; 4 draft gauges; 1 Orsat gas apparatus. A. W. Payne, Clk. of Council.

Okla., Tonkawa—$60,000 bonds voted and sold for water works extensions. Contract will be let as soon as funds are available. Johnson & Benham, Consulting Engrs., 6th Floor, Firestone Bldg., Kansas City, Missouri.

Ore., Medford—City Engr. Walker and Water Supt. Hosler inspecting site for 25,000,000-gal. reservoir. Water meters will also be installed.

Pa., Erie—New reservoir will be built in Glenwood. Surveying of site will be started at once.

Pa., Farrell—Ord. passed to issue $49,000 bonds for extension of water works and electric light plant. J. H. Micheltree, Pres. of Council.

Tex., Gorman—City will construct $200,000 water and sewer systems. J. C. Davis, Mayor. Henry Exall Elrod Co., Engrs., 209½ Lane St., Dallas.

Tex., San Angelo—City Comn. has instructed City Mgr. E. J. Wells, Jr., to proceed at once to sink necessary test wells to determine best location for city water supply.

Tex., Wichita Falls—City considering expendt. of $3,000,000 for water works system. Plan provides for creating reservoir by damming Wichita River and includes furnishing of water for 150,000 acres of irrigated land.

Utah, Salt Lake City—City Commr. C. C. Nasslen has proposed plans for perm. water supply for city which will involve constr. of large reservoir on the Weber and Provo rivers.

Wash., Ballard—City Utilities Comm., of the City Council, has decided to substitute wooden water mains in Ballard district with iron mains. Est. cost approx. $500,000. The worn out wooden mains must be replaced immediately or it will become necessary to shut off water to the district.

Wash., Seattle—Plans for constr. wk. and materials required in creation of Swan Lake impounding reservoir are being revised and it is expected bids can be asked late this Fall. Complete system will cost about $8,182,000; Conc. conduit, Landsberg to Swan Lake, including rebldg. of intake, $573,000; develop. of Swan Lake, including aqueduct to Molasses Creek, $777,000; replacing No. 1 line with steel, 625,000; replacing No. 2 line with steel, $1,180,000; steel pipe line No. 3, Molasses Crk. to W. Seattle, $1,650,000; steel pipe line No. 4, Molasses Crk. to Volunteer Park, $1,600,000;

enlarging Volunteer Pk. reservoir, $190,000; enlarging Lincoln Pk. reservoir, $70,000; reservoirs at W. Seattle, $483,000; distribution enlargment of main in city, $1,034,000.

Wis., Rio—Engr. W. G. Kirchoffer, Madison, retained by Village Board to make plans, specfs. and estimates for a water works system for the village. Test vote at recent election showed majority of citizens in favor of impvt.

BRIDGES AND BUILDINGS

Ark., Hot Springs—Business Men's League and citizens from Cedar Glades and Buckville, northern part of county, have discussed plans for constr. of bridge over Ouachita River. It is intended to ask State Hwy. Dept. to make immediate survey and determine cost of struct. Roughly estimated cost of bridge will be betw. $25,000 and $50,000.

Ariz., Phoenix—Maricopa Co. will pay one-quarter of expense of bldg. bridge superstruct. on new Gila Bend canal diversion dam across the Gila—short distance below mouth of the Hassayampa, $38,000.

Cal., Newport Beach—Pacific Electric & Southern Pacific R. R. companies have arranged with Orange County harbor commission to construct joint bridge over new mouth of Santa Ana river. Bridge will consist of three 60-ft. steel spans with rein. conc. piers and pile trestle approaches. County will pay $20,000 of cost of structure.

Cal., Porterville—Comm. appointed by Council has recommended that low arch bridge (rein. conc.) be erected on Main St. over Porter slough. City Engr. F. W. Pease estimates cost of struct. at $30,000.

Fla., Miami—$70,000 bonds voted for construction of bridge over Miami River.

Fla., Palm Beach—Palm Beach Co. will vote on issuance of $250,000 bonds for construction of conc. bridge betw. Palm Beach and W. Palm Beach.

Fla., St. Augustine—Bids will be asked about Dec. 1st, by St. Johns Co. Commrs., for rein. conc. bridges on Dixie Hwy.; conc. brdg. over Matanzas River, 16-ft. conc. bridge to North Beach. $300,000. G. T. Butler, Engr.

Ga., Americus—A. T. Crossland, Fed. Hwy. Engr. for southern dist. (headquarters in Atlanta) has approved two Fed. Aid Projects for conc. bridges; one to be built over Sweetwater Creek and the other over Viney Branch.

Ill., Rockford—Temporary bridge will soon be built over Rock River at Rockton. Co. Hwy. Supt. A. R. Carter, making survey preparatory to erecting temp. bridge, and later, a permanent structure.

Ind., Indianapolis—Co. Commrs. petitioned to repair Kentucky Ave. bridge over Eagle Creek and to construct new bridge later. Est. cost of new bridge, $50,000.

Ia., Oskaloosa—Bridge will be constructed over Skunk River betw. Mahaska and Powieshiek counties. Co. officials have not agreed on site. R. W. Varley, Co. Aud. Oskaloosa.

Kans., Galena—Rickner's bridge over Shoal Creek, 3 miles so. west of here, is to be improved. Plans completed by Cherokee Co. Commrs. and Trustees of Galena Twp.

Kans., Junction City—90-ft. conc. brdg. will be built over Lyons Crk., 4 miles south of here.

Mass., Springfield—Revised bridge report filed with Supreme Court, for new Conn. River bridge. Report provides for conc. straight bridge, 80 ft. wide, across river to W. Springfield in direct line from Vernon St. Est. cost $3,608,000, city's share to be $2,453,440. Plans provide for navigation draw in main span and for struct. of sufficient strength to permit the hauling of the heaviest ordnance used by the government.

Mich., Detroit—Bridges are to be built over the River Rouge at W. Jefferson and West Fort St. Each bridge will cost $800,000.

Minn., Austin—Plans completed by State Hwy. Comn., Guardian Life Bldg., St. Paul, for Bridge 3141, Marshall Twp. O. J. Simmons, Aud., Austin.

Minn., Minneapolis — Congressional authority for Hennepin County to construct and operate Lyndale Ave. bridge, granted in bill passed by Senate County Commrs. have authorized bond sale. Bridge will be of steel, 823-ft. long, with concrete piers.

Minn., Minneapolis—Work on the Lake Nokomis bridge will proceed. City Engineer has made plans to construct bridge at cost of $100,000, which amount if available.

Minn., Moorhead—Plans completed for bridge No. 3013, Elmwood Twp., Clay Co. Erick Martinson, Engr., Moorhead. Specfs. by State Hwy. Comn. St. Paul.

Minn., Olivia—Will take bids during winter for constr. of Bridge No. 3129 Norfolk County. F. M. Shepard, Engr., Olivia. J. L. Johnson, Co. Aud.

Miss., Belzoni—$150,000 bonds voted by Humphreys County for bridges and roads.

Miss., Poplarville—Pearl Co. Commrs. considering steel and conc. drawbridge spanning Pearl River; $600,000 available. Xavier A. Kramer, State Hwy. Engr., Jackson.

O., Cleveland—Street Railway Commr. Sanders reports that two bridges across the Cuyahoga river must be rebuilt before completion of new street railway line in the flats district.

O., Columbus—West siders and members of So. Side Civic Assn. have decided to ask County Commrs. permission to construct bridge at Greenlawn Ave., over Scioto river.

O., Youngstown—Bridge 60-ft. wide, extending from near Hine St. on each to betw. Watt and Walnut Sts. on west, is to be built. Est. cost approx. $553,000.

Ore., Salem—State Hwy. Dept. considering bldg. a double leaf trunion bascule bridge across Youngs Bay at Astoria, Clatsop Co. Plans for structure practically complete. Herbert Nunn, State Hwy. Engr. State House, Salem. Dep. $10 required for safe return of plans. Date for receiving bids not definitely set but will doubtless be in November or early December. Bids will be received on 3 altern. projects: Proj. No. 1—Bascule brdg. for comb. railway & Hwy. traffic, including abt. 1580 lin. ft. timber trestle approach span for hwy. proj.

Okla., Miami—Co. Bd. Commrs. have decided to move brdg. which spans Neosho River here, to location west of Commerce. Election soon to vote on $50,000 bonds for constr. of bridge of larger size and of concrete at Miami.

Pa., Philadelphia—Direct. Datesman proposed plans for bridge on line of 40th street at cost of $130,000, in order to improve traffic facilities. Bids will be asked as soon as Council passes 2 Ords.; one authorizing the impvt. and the other appropriating funds.

S. D., Clear Lake—Petitions for 8 bridges and culverts granted in Deuel County. G. O. Halvorson, Co. Aud.

S. D., Mitchell—Board Co. Commrs. Davison County, has set aside sum of $50,000 for erection of 23 bridges. None of the structures will be large.

Tex., Bonham—Board of Trade, C. R. Inglish, Secy.; organizing company for purpose of constructing 800 ft. toll bridge on Red River; 4 spans; cantilever; extend roads to approaches, $125,000.

Tex., Orange—Orange County Commrs. considering constr. of bridge across Sabine River; improve county highways; $1,000,000 bonds.

Wash., Yakima—Commrs. Yakima Co. contemplate raising and repairing Piland Bridge. steel span. Abt. $10,000. W. C. Marion, Co. Engr.

Wash., Yakima—$45,000 appropriated by Co. Commrs. for repair of lower Moxee bridge. Work may be undertaken this Fall.

Wis., Madison—Plans prepared by Wisc. Hwy. Comn., for Engelke brdg., town of Belmont, Lafayette County. Est. cost $3,400. G. H. Priestley, Commr.; also for Henrietta brdg., Henrietta, Richland Co., $3,925. M. O. Carter, Commr.; Wittenwyler brdg., Monticello, Green Co., $3,880 and J. Wittenwyler brdg., Monticello, $3,600. E. L. Edwards, Commr.; McGray brdg., Friendship, Fond du Lac Co., $3,300. Geo. Treleven, Commr.; Oak brdg., Muckwa, Waupaca Co., $9,000. C. J. Knudson, Commr.; Westberg brdg. No. 2, Stockholm. Est. $2299. Gale Goss, Commr. (Pepin County).

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

OF MUNICIPAL AND COUNTY ENGINEERING published monthly at Indianapolis, Indiana, for October 1, 1919.

State of Indiana, County of Marion, ss:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared John H. Pritchard, who, having been duly sworn according to law, deposes and says that he is the Business Manager of MUNICIPAL AND COUNTY ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publishers, editor, managing editor, and business manager are:

Publisher, Engineering Publishing Company, Inc., 702 Wulsin Bldg., Indianapolis, Indiana.

Editor, Samuel C. Hadden, 538 South Clark Street, Chicago, Illinois.

Managing Editor, Samuel C. Hadden, 538 South Clark Street, Chicago, Illinois.

Business Manager, John H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

2. That the owners are:

Engineering Publishing Company, Inc., 702 Wulsin Building, Indianapolis, Indiana.

Alexander P. Fox, 704 Wulsin Building, Indianapolis, Indiana.

George O. Wildhack, 927 North Meridian Street, Indianapolis, Indiana.

John H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

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JOHN H. PRITCHARD,
Business Manager.

Sworn to and subscribed before me this 6th day of October, 1919.

(Seal) WALTER P. HANNA.

(My commission expires April 4, 1920.)

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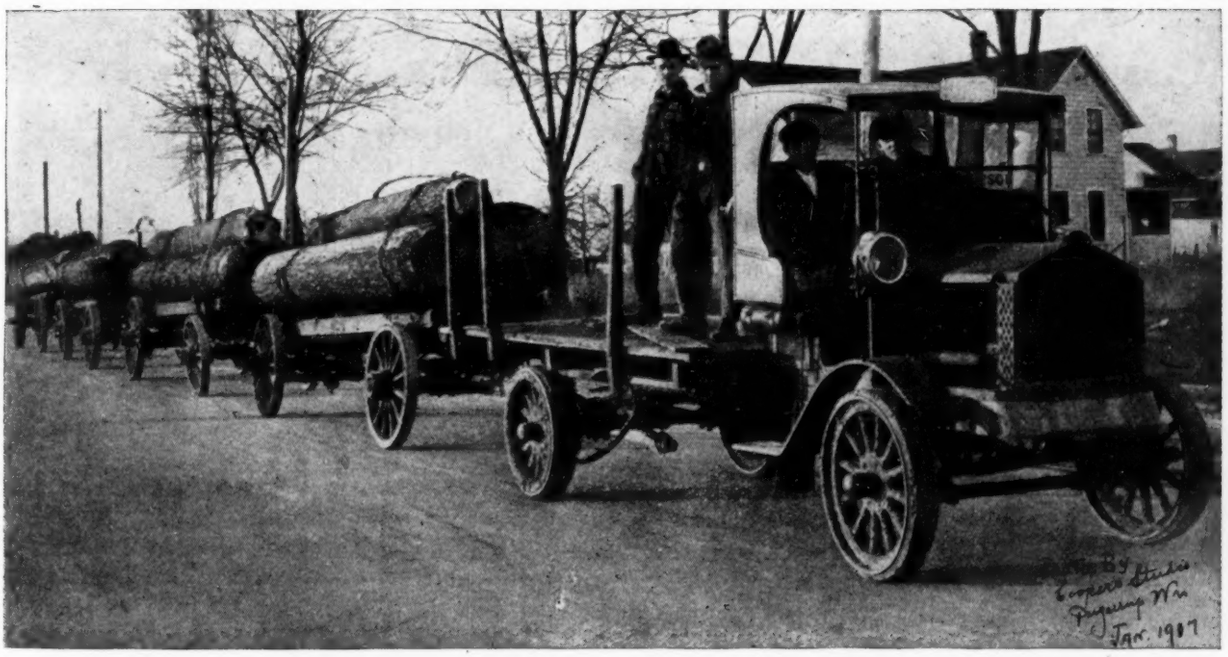

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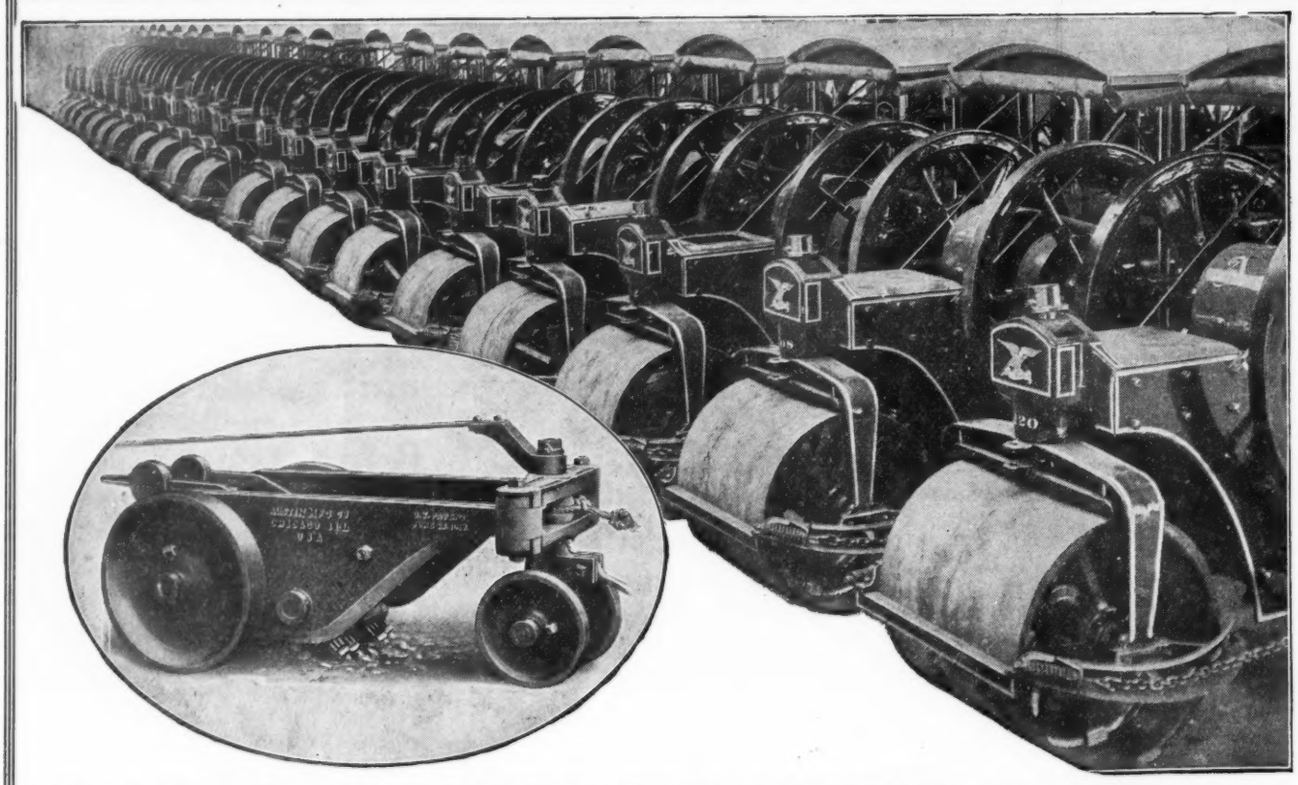

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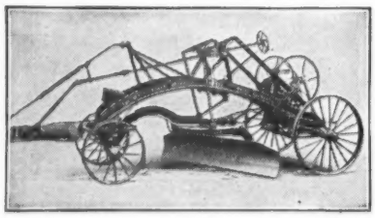

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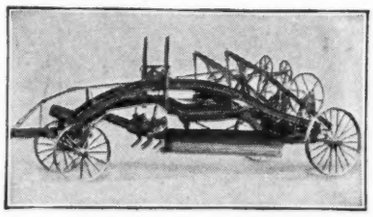

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